

COMPUTER MEDIATION IN SUPPORT OF A
CONSTRUCTIVIST LEARNING STRATEGY AT AN
HISTORICALLY BLACK UNIVERSITY IN LIMPOPO, SOUTH
AFRICA

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Abstract

This implementation study set out to establish the impact of a constructivist-informed, computer-mediated course on perceptions and performance of the student participants. The course was designed to meet the requirements of a physiology course offered at the second (final) year level. The context in which the study took place was defined by the fact that the institution concerned is an historically black university in South Africa. During the design of this course particular emphasis was placed on the development of an authentic learning environment in the constructivist-informed cognitive apprenticeship tradition. The results of this study were particularly important in light of the instructivist-informed educational background, both at school and at university, of the student participants and their lack of exposure to the information and communication technologies used to support this course.

At the end of the course student participants were requested to complete a Subject Evaluation Questionnaire in an attempt to establish student perceptions of the course. Both qualitative coding procedures and quantitative frequency testing were used to analyse student responses to the questions. Student performance in this course was compared to student performance in the course in the previous year (2001). This was done by comparing the results of a paired samples *t*-test undertaken on student achievement in this course (PLGY232) and one other course undertaken during the year (PLGY242) for both years. Reference was also made to the researcher's reflective journal in analysing the results.

The results for four categories of question elicited from the Subject Evaluation Questionnaire, namely, Good Teaching, Goals and Standards, Generic Skills and Overall Rating of the course, indicated that these aspects of the course were positively perceived by the student respondents. On the other hand, Workload and Assessment appear to have been negatively perceived by the student respondents. Qualitative analysis of the student responses supports this finding. The results of the paired samples *t*-test analysis of student performance in both years indicate that students in the course under discussion appeared to have performed better than

their counterparts the previous year. However, more rigorous statistical analysis would be required to substantiate the significance of the difference in student performance.

In the final analysis, the results of this study seem to indicate that students participating in this course benefited from the approach employed. Furthermore, exposure to both information and communication technology and to a constructivist approach did not seem to impact negatively on either student perceptions or student achievement. This augers well for future implementations of constructivist-informed, computer-mediated courses. The lessons learned from this study will certainly inform future endeavours at this institution to improve the quality of student learning.

Chapter 1: Introduction

This research project was undertaken at the University of the North in the province of Limpopo, South Africa. This project represented one of the first attempts by the University of the North to employ computer- and World Wide Web-based technologies in its curriculum in mediation of the teaching and learning at the institution. It was the first attempt at documenting the implementation of a course of this nature at this institution.

In order to set the scene, as it were, this chapter deals with the background of the institution and its students, with particular reference to the course on which this research project was based; the personal motivation of the researcher in undertaking this study; the aims or objectives of the study; and, finally, the research questions being asked in this study.

1.1 Background

The University of the North is what is known as an historically black university in the South African context. This designation is loaded with numerous connotations, and its dissection a veritable minefield. What is important in the context of this project, however, is the fact that more than 80% of the students who attend this university come from a rural background and attended rural schools. The implications of the *status quo* in the context of this project are two-fold.

In the first instance, student learning experience prior to attending university is steeped in the instructivist paradigm, grounded in the Apartheid government of South Africa's philosophy of Christian National Education, moulded by its Bantu Education policy. While it is not the purpose of this thesis to examine the effects of Apartheid on the education system developed by the Apartheid government for black South Africans, it is important for the reader to understand that the primary aim of Bantu Education was to develop and implement separate education standards for white

and black South Africans. In the words of Dr Hendrik Verwoerd, Minister of Native Affairs from 1950 – 1958:

There is no place for him [black South Africans] in the European community above certain forms of labour.

and:

Education must train and teach people in accordance with their opportunities in life.

(Verwoerd, undated, cited in Smook, 1999:online)

Responsibility for the development and implementation of policy governing the education of black South Africans fell within the ambit of Verwoerd's portfolio as Minister of Native Affairs.

The principle of Bantu Education was extended to the university system in South Africa with the introduction of the Extension of University Education Act (No. 45) of 1959 which prohibited black South Africans from attending institutions reserved for white South Africans. According to Mandela (1957) the main purpose of the Act was the establishment of:

... tribal colleges, controlled by party politicians and based upon the doctrine of the perpetual supremacy of the whites over the blacks. Such colleges would be used by the government to enforce its political ideology at a university level.

The University of the North was established in 1959 as such a college and, while the institution struggles through its transformation, the legacy left by the Apartheid philosophy is still very much in evidence. However, since the advent of democracy based on a universal franchise in South Africa a number of important changes have been made with respect to education policy, not the least of which is the development of the eight critical or generic outcomes required from education and training interventions in South Africa, namely:

- Identifying and solving problems (critical thinking skills);
- Working together in groups or teams;
- Organising and managing oneself;
- Collecting and handling information;
- Communicating effectively;
- Using or applying science and technology;

- Demonstrating an holistic world view; and
- Applying professional and social life skills.

(The National Qualifications Framework, 2000)

Part of the institution's transformative process revolves around the incorporation of these ideals into its curriculum and computer-mediated the development of curricula supported by sound pedagogy is one of tools at the institutions disposal.

In the second instance, the rural background from which students come usually means little or no access to technology in any form, in the modern sense of the word. Student learning experience and life experience is generally devoid of things that urban dwellers take for granted. More often than not both homes and schools in the rural areas do not have access to electricity, so it is unlikely that students have been exposed to modern technology in any shape or form in their formative years, let alone the world of computer- and World-Wide Web-based technologies. In contrast, their urban counterparts are products of the so-called Y-generation, for whom technology is a way of life.

Cognizance must also be taken of developments in higher education world-wide, where research in the field of educational technology, specifically into the use of computer- and World Wide Web-based technologies, has resulted in an increasing sensitivity towards the shortcomings of current practice in tertiary education and the educational theory that underpins this practice (Laurillard, 1993). These shortcomings are particularly manifest in the inability of learners to draw on what they have learned as students in real life situations (Wild and Quinn, 1998:76-77; Brown, Collins and Duguid, 1989:online; Cognition and Technology Group at Vanderbilt, Learning Technology Center, 1993:75; Laurillard, 1993:15; Herrington and Oliver, 2000:online).

This project was implemented against the backdrop of these considerations, while the aims of the project are dealt with in the next section.

1.2 Aims of the Study

With the above in mind, this study documented the implementation of a constructivist-informed, computer-mediated course in a second (final) year course in the discipline of Physiology at the University of the North. Particular emphasis was placed on the development of an authentic learning environment in the cognitive apprenticeship tradition. The aim of the study was to determine whether the implementation of this course would enhance the worth of the course in the eyes of the learners participating in the course and affect the academic achievements of those participants.

This study was important primarily because the University of the North took a strategic decision in 2000 to embrace the use of computer- and World Wide Web-based educational technologies in its curriculum. This study represented one of the first initiatives in this regard, and its importance lies in the fact that it was an early opportunity to document the implementation of such a course at this institution, particularly in light of the technology-poor background of our students. The study was also important in the context of examining alternative approaches to the instructivist paradigm that currently dominates education delivery at this institution, particularly in light of the rigidly instructivist-informed education background of both academic staff and students at this institution referred to in the previous section.

The results of this study are significant in the context of this institution's transformation from an historically black institution in South Africa to an institution that can make meaningful contribution to the higher education landscape in the country.

So, with this in mind, it is now pertinent to pose the questions required to satisfy the aims of this study.

1.3 Research Questions

This study attempted to answer five research questions. The primary research question involved student satisfaction with the course:

1. How did the implementation of a constructivist-informed, computer-mediated course in a second (final) year course in the discipline of Physiology at the University of the North, with particular emphasis on the development of an authentic learning environment in the cognitive apprenticeship tradition, enhance the worth of the course in the eyes of the learners participating in the course?

Although not explicit in the primary research question, questions relating to how students coped with the technology and how students coped with the approach are implied and needed to be given serious consideration when dealing with the research question:

2. How did the students participating in the course experience the computer mediation?; and,
3. How did the students participating in this course experience the approach?

It was important to document any problems that were encountered with the implementation of the course in order to build on the experience to improve any future course offerings:

4. What issues arising from the implementation of this course would need to be addressed in order to improve the chances of success in future courses of similar design and approach?

Finally, it was important to look at the effect of the course on student performance:

5. What effect did the implementation of this course have on the academic achievements of those participants?

As this study represented the first tentative step into the world of computer-mediated learning it was decided to limit the boundaries of this study at the outset. In the first instance this study represents the first of its kind at the University of the North and, therefore, there is no historical data to fall back on, or which can be used to make

any comparisons. Furthermore, Reeves (2000:online) suggests that one of the problems with instructional technology research is the duration of research projects and that meaningful results are only really obtainable in participatory research projects of at least five-year duration. This is not possible in a study of this nature. However, this study will inform the development of a long-term study monitoring the implementation of online learning, in its many guises, at this institution, particularly with respect to the design of the research approach.

Finally, it was decided not to employ rigorous quantitative methodology in order to answer the second research question, namely the effect of implementation of the course on student performance. This decision was taken because it was realised at the design stage that it would be difficult to deploy the checks and balances required by rigorous quantitative methodology in an implementation study of this nature, with all the variables that this type of study entails. Rather, it was decided to apply quantitative methodologies simply to establish how the students participating in the study fared in terms of their performance compared to the student cohort undertaking the same course in the previous year. One of the factors making the use of sound qualitative measurements difficult was the fact that the results obtained by the students participating in the course in the previous year (2001) were not available, making direct comparisons with the study year (2002) impossible. However, student performance in this course in 2001 was reflected in the final module mark, contributing 30% to that mark, as was the case in 2002. It was therefore possible to make comparisons between the marks students obtained for the module PLGY232 in both years and this comparison was used as a measurement merely to establish what effect the course had in order to ensure that the course did not have a detrimental effect on student performance.

The next section, Theoretical Framework, deals with the theory, gleaned from the literature, which underpinned the study. In the first instance it was important to try and establish from the literature what is meant by learning and how it is brought about. It was then necessary to look at the numerous learning theories, including the learning approach that the students in this study were most familiar with, namely instructivism, and the learning theory that underpins this study, namely constructivism. Finally, questions of a practical nature are discussed, with reference

to the literature, in respect of the design requirements of a constructivist-informed computer-mediated course such as implemented in this study.

Chapter 2: Theoretical Framework

This chapter deals with the theoretical considerations that governed the design and implementation of the study, starting with an examination of what learning means in a higher education environment, then looking particularly at the dominant paradigm currently supporting education at the University of the North and examining alternatives with specific reference to the use of computer- and World Wide Web-based technologies in the curriculum. After consideration of paradigms, aspects of instructional design will be considered with reference to paradigm choice before examining student experiences in online learning environments. Finally and overview of the study will be discussed with respect to the theoretical framework.

Education can be defined as an enterprise, i.e. a human activity, task or endeavour, in which the educator employs “desirable methods” to develop “desirable dispositions” in the educated (Frankena, 1973:online).

The enterprise of education is informed by, and related to, the discipline of education and other supporting disciplines, such as philosophy and psychology, relying on guidance from theory and science for its practice (Frankena, 1973:online). While there may be agreement about the definition of education as an enterprise and education as a discipline – as Frankena (1973:online) points out, “all kinds of theories of education have the same basic presuppositions” – there are myriad opinions on the role of the educator, the role of the educated and the methods used to foster Frankena’s (1973:online) “desirable dispositions”. This is particularly true of mass higher education where the actual – a situation where teachers control the what and how of student learning – is far from what is aspired to – a situation where students take responsibility for their own learning within a community of learners (Laurillard, 1993:2).

Before examining how different theories define these roles it is important that we understand what is meant by learning and how learners in an academic environment learn.

2.1 Learning and the Literature

Merriam Webster Online (2004) defines learning as “to come to know”. This is a rather simplistic definition. In an academic sense of the word the definition of learning depends on one’s philosophical or epistemological perspective, which is immediately evident when one compares the following two definitions for learning.

From the behaviourist perspective:

Learning is a relatively permanent change in behavioural potentiality that occurs as a result of reinforced practice.

(Kimble, 1961:6)

For constructivists, on the other hand, learning, according to Ally (2004:20), is:

... the development of new knowledge, skills and attitudes as the learner interacts with information and the environment.

(Ally, 2004:20)

But there is more to the process of learning and it is important that this is understood when designing courses at this level. It would appear that the emphasis on assessable outcomes in higher education has had the tendency to promote rote learning (Entwistle, 1988:35). This state of affairs is, according to Dahlgren (1984:23), further compounded by a conception of knowledge that is both quantitative and reproductive, leading to an inability in learners to apply what they have learned as students in real life situations as a result of the separation of theory and practice and the deconstruction of knowledge and decontextualisation of learning (Brown, Collins and Duguid, 1989:online; Ramsden, 1992:39; Laurillard, 1993:15-17; Herrington and Oliver, 2000:online; Herrington *et al.*, 2004:4). As Herrington and Oliver (2000:online) put it:

When learning and context are separated, knowledge itself is seen by learners as the final product of education rather than a tool to be used dynamically to solve problems.

What education in general and higher education in particular should be striving for is learning which emphasises multiple models and viewpoints of a particular domain and the relationships between these models and viewpoints, along with the ability to solve quantitative and qualitative problems in that domain through the application of

first principles and reasoning based on these principles (Sandberg and Barnard, 1997:16).

In 1984 Marton went to the learners themselves for answers (Entwistle, 1988:50). Focussing on learning from the students' perspective, Entwistle (1984:1) explains that their task was:

... to describe more clearly how learning takes place in higher education and to point out how teaching and assessment affect the quality of learning.

In this study Marton and Säljö (1984:39) found that:

... the students who did not get "the point" failed to do so simply because they were not looking for it.

They subscribe this failure to the approaches taken by the students when presented with the texts:

The main differences we found in the process of learning concerned whether the students *focused on the text in itself or on what the text was about; the author's intention, the main point, the conclusion to be drawn.*

Marton and Säljö (1984:39-40)

These differences in the level of processing led Marton and Säljö to postulate that the students concerned were using different approaches to their learning, identifying surface and deep processes. The process adopted by the student was, according to Marton and Säljö (1984:42-43) and Entwistle (1988:58), related to learning outcome.

Marton and Säljö were also able to link student motivation to "choice" of approach by students:

Learning or reading out of interest, a wish to find something out (i.e. due to intrinsic motivation), can reasonably be expected to be linked with a deep approach. On the other hand, comments from students who had adopted a surface approach showed that they had tried to memorize the text because they felt that this was required of them.

(Marton and Säljö, 1984:50-51)

It is important to point out here that students themselves were not and cannot be classified as either surface or deep learners, but that students may adopt specific approaches to specific situations (Entwistle, 1988:61) which will be determined by

the students' motivation to engage in the learning of particular material (Marton and Säljö, 1984:50-51) and by the use of materials (Dahlgren, 1984:23).

Entwistle (1988:69) later identified a third approach to learning, called strategic learning and defines this approach as the process used by a student to produce the best result, or "pay-off", employing aspects of both deep and surface learning, coupled with time and effort management.

The following table from Entwistle (1988:69) summarises approaches to learning in relation to student motivation.

Table 1: Motivation and Approaches to Learning

Motivation	Intention	Approach	Processes
Intrinsic	Understand	Deep	Relate to previous knowledge and experience
Fear of failure (extrinsic)	Complete task requirements	Surface	Memorise discrete items of information
Need for achievement	Obtain highest possible marks	Strategic	Allocate time, effort and approaches according to "pay-off"

So, it is important that the learning approach taken in an academic environment should be designed to encourage the adoption of deep learning strategies, or at the very least, strategic learning strategies, by the students so that students achieve a more holistic understanding of the discourse (Laurillard, 1993:50-56). Exposing learners to complex, content-related deep learning environments are more likely to transfer learning from one situation to another (Cognition and Technology Group at Vanderbilt, Learning Technology Center, 1993:76, 78). As Wild and Quinn (1998:76) point out:

... it is important to induce in learners, a conceptualisation of the task being tackled that leads them to consider the structure rather than the detail of related knowledge. This is achieved by providing for appropriate tasks, so that learners are not reduced to retaining and producing discrete and unrelated facts.

Wild and Quinn (1998:76) emphasise the importance of shifting control over learning to the learners in an unstructured, but supported, learning environment as a means

of promoting deep learning. In an effort to improve learning at university level Laurillard (1993) developed what she calls a principled teaching strategy (Laurillard, 1993:94), which Laurillard admits is prescriptive but necessarily so if, in her view, the strategy is to “result in improved quality of learning” (1993:95).

The learning process must be constituted as a dialogue between teacher and student, operating at the level of descriptions of actions in the world, recognising the second-order character of academic knowledge, and having the following characteristics:

Discursive

- teacher’s and student’s conceptions should each be accessible to the other;
- teacher and students must agree learning goals for the topic and task goals;
- the teacher must provide an environment within which students can act on, generate and receive feedback on descriptions appropriate to the topic goal

Adaptive

- the teacher has the responsibility to use the relationship between their own and the student’s conception to determine the focus of the continuing dialogue

Interactive

- the students must act to achieve the task goal
- the teacher must provide meaningful intrinsic feedback on actions that relates to the nature of the task goal

Reflective

- the teacher must support the process in which students link the feedback on their actions to the topic goal for every level of description within the topic structure

(Laurillard, 1993:94)

In this section I examined learning in the context of a higher education learning environment. It is now important to go to the literature to examine the dominant paradigms that currently support the design of learning environments to see how they can guide us in the development of the sort of learning environment that will promote the sort of learning required in an academic learning environment. This exercise is made particularly difficult by the fact that, as Laurillard (1993:14) puts it:

... there is comparatively little research on student learning at university level.

Moreover, the exercise appears to be fraught with danger. As von Glasersfeld put it:

To introduce epistemological considerations into a discussion on education has always been dynamite. Socrates did it, and he was promptly given hemlock.

(Von Glasersfeld, 1983:online)

2.2 Pedagogical Paradigms – what is true and what is real?

Drawing on Kuhn (1996), Vrasidas (2001:2) defines a paradigm as a:

. . . set of beliefs, examples, or traditions that guide a certain scientific community on how to conduct its practices.

In the case of learning, paradigms guide the research community in its quest to explain how human beings come to understand new things (Phillips and Soltis, 1998:9) and the education profession in its practice, both important considerations when considering the role that technology can play. However, some authors warn that theory can negate lessons that can be learnt from reality (Anderson, 2004:33, online) and emphasis should be placed on the word *guide* so as to avoid prescription.

Gage's (1989:1) "paradigm wars" of the 1980s continue to be waged as we enter the early years of the 21st Century. It is clear that the latter part of the 20th Century witnessed the continued ascendancy of what Gage calls antinaturalist, interpretivist and critical theorist influence on education over behaviourist psychology (Gage, 1989:1).

However, it is important that we understand the influence of the traditional epistemological paradigm, not the least because of its continued influence on the educator, the educated and the methods employed in education today before examining possible alternatives in the context of this study. This examination is particularly important because of the influence of this philosophy on students at the University of the North throughout their learning careers.

2.2.1 Behaviourism – learning as a result of stimulus and response

According to Black (1995:online), behaviourism has its roots or intellectual ancestry in the empiricist (Ertmer and Newby, 1993a:online) works of the Associationists. Associationist philosophy drew its inspiration from the works of Aristotle, particularly from an essay published by Aristotle in 400 BC entitled “Memory”. In this essay Aristotle postulates that associations are made between objects because these objects are, in some way, related to one another. In 1740 the Associationist, David Hulme, proposed that frequently occurring associations become more firm, while those occurring less frequently become more difficult to recall (Black, 1995:online). At the turn of the 20th Century, Hermann von Ebbinghaus (1859-1909) influenced associationist thought by proposing that learning increased in proportion to the frequency with which a particular association was made. He postulated that associations most recently formed were strongest and that these associations would decay with time, unless reinforced (Black, 1995:online). In this approach one can already see the first glimmers of what was to become behaviourist education psychology.

Behaviourist psychology began to take shape out of associationist thought as a result of the now well-known work of Ivan Petrovich Pavlov (1849-1936), the Nobel Prize winning Russian professor of medicine. Pavlov’s idea of conditioned reflex to a stimulus was born out of his “salivating dogs” studies in which dogs were conditioned to respond to various stimuli that these animals came to associate with food (Black, 1995:online; Philips and Soltis 1998:23). Edward Thorndyke’s (1874-1949) theory of Connectionism proposed that learning was the result of associations – called “getting the idea” by Philips and Soltis (1998:25) – being developed between stimulus and response (Kearsley, 1994a:online). Thorndyke called these associations habits and postulated that these habits could be strengthened or weakened as a result of the nature and frequency of the stimulus-response pairings. In other words, certain responses could be made to dominate over others through a process of systematic reward or punishment of the responses through a process of trial and error (Kearsley, 1994a:online).

However, John Broadus Watson (1878-1958) is considered the founder of behaviourism as a psychology (Peters, 2003:online). According to Peters (2003:online) and others (Skinner, 1974:5,6; Phillips and Soltis, 1998:21-22), the feeling at the time was that if psychology was to gain credence in a world dominated by the scientific method then its research approach and findings would have to be based on the sort of objective observations and measurements applied in the biological and natural sciences (Watson, 1913:online). Watson rejected measurements of the processes of the mind because he believed that “introspective” reporting would not stand up to the sort of validation demanded by the scientific method, i.e. objectivity and replicability (Watson, 1913:online; Phillips and Soltis, 1998:22). Watson’s behaviourism had as its goal the “prediction and control of behaviour” (Watson, 1948:457). Watson is credited as being the founder of the associationist-informed stimulus-response theory of learning (Peters, 2003:online).

What is of interest to education is the fact that Watson’s:

... doctrine fitted well with the thinking of a nation, one of whose basic problems was to create American citizens out of a multitude of diverse origins, and who, in their approach to life, combined a pragmatic outlook with a high level of technical skills, and a friendly extroverted disposition with an optimistic attitude towards the future.

(Peters, 2003:online)

Watson’s work was heavily influenced by Pavlov’s work on animals. He focussed on Pavlov’s idea that these animals were “biologically wired”, as Phillips and Soltis (1998:23) put it, to respond in specific ways to certain stimuli. Watson’s theory of classical conditioning applies this idea to education, in particular the education of children. Watson’s ethically questionable study involving “Little Albert”, an 11-month old baby, conducted in 1922 showed that by associating an unconditioned response – in this case fright – with unconditioned stimulus – in this case a loud noise – in the subject’s mind, with a conditioned stimulus – in this case a mouse, he could bring about a conditioned response – in this case fear – to that conditioned stimulus in the absence of the unconditioned stimulus (Bauer and Maracich, 2003). While Watson’s theory may account for learning in response to stimuli the learner receives from the learning environment, it does not account for abstract learning (Phillips and Soltis, 1998:24-25), the sort of learning required of a tertiary education environment.

Edwin Ray Guthrie (1886-1959) supported the idea of learning as a result of an association between responses to stimuli (Kearsley, 1994b:online). His theory of Contiguity recognised that associations of stimulus and response that are close together in time or space, i.e. contiguous, can bring about a change in behaviour (Open Learning Technology Corporation Limited, 1996:online). Furthermore, Guthrie's theory postulates that forgetting is the result of stimuli becoming associated with new responses and therefore old responses become unlearned, rather than forgotten as a result of the passage of time (Open Learning Technology Corporation Limited, 1996:online). However, Guthrie did not believe that behaviours were learned, rather that movements were learned as a result of the effect of stimulus and response on specific sensory-motor patterns (Kearsley, 1994b:online).

Probably the most important influence on behaviourist educational theory came from Burrhus F Skinner (1904-1990). Skinner believed that behaviourism was "not the science of human behaviour but the philosophy of that science" (Skinner, 1974:1). He rejected the works of many of the early behaviourists as misleading and the source of a number of misconceptions about this philosophy, including the criticisms that behaviourism of that time, i.e. that behaviourism:

- . . . ignores consciousness, feelings and states of mind;
- . . . formulates behaviour simply as a set of responses to stimuli, thus representing a person as an automaton, robot, puppet, or machine;

and

- . . . does not attempt to account for cognitive processes.

He based his theory of Operant (or voluntary) Conditioning – as opposed to respondent (or involuntary) conditioning – on the idea that it was the act of changing of an observable human behaviour that brought about learning (Skinner, 1974:39; Kearsley, 1994c:online). Skinner thought that the consequences of responses to stimuli may either be positive (reward) or negative (punishment) and that the rewarding of positive responses would bring about learning through the reinforcement of these responses (Skinner, 1974:39-40, 46; Kearsley, 1994c:online; Reeves and Hedberg, 2003:12; Reeves and Hedberg, 2003:192). Moreover, Skinner proposed that positive responses could be more effectively achieved through the

judicious application of reward (Phillips and Soltis, 1998:28). According to Entwistle (1988:8), Skinner's behaviourist learning depended on:

1. breaking down what was to be learned into small steps, and ordering them into logical sequence;
2. rewarding initially correct responses immediately, but using intermittent reinforcement thereafter; and
3. Identifying relevant existing behaviour and progressively shaping it by reinforcement until it fitted the specified new behaviour pattern.

Dissatisfied with teaching practices of the time, Skinner built teaching machines, which presented learning to learners in small, deconstructed, units. Learners were rewarded for correctly solving problems related to the content, prompted when they appeared to be stuck and assisted when they got the answer wrong – with the aim of shaping behaviour (Entwistle, 1988:8; Phillips and Soltis, 1998:28).

While Skinner accepted that humans have “inner lives”, he believed, as did many behaviourists of that era, that data obtained about these “inner lives” could never be a reliable foundation on which to build a science (Peters. 2003:online) and he chose to ignore its influence on learning. Instead, he believed that operant conditioning was a product of natural selection and, as such, its value lay in its influence on human survival rather than satisfying human feelings (wants, needs, desires and wishes) (Skinner, 1974:47).

In summary: the teacher-centred behaviourist or objectivist educational psychology has its roots in the teachings of Aristotle (Black, 1995:online). Behaviourism has learning defined in terms of the acquisition of the truth (Reeves and Hedberg, 2003:191) or knowledge of the real world (von Glasersfeld, 1996:3), which, in objectivist discourse, is both observable and measurable and is brought about through conditioning, which is both observable and measurable (Ertmer and Newby, 1993b:online; Reeves and Hedberg, 2003:12; Reeves and Hedberg, 2003:192; Ally, 2004:7). The behaviourist educational psychology is supported by the basic tenets of objectivist thought as defined by Vrasidas (2000:2-3, online) and echoed by Jonassen (1991:28-29):

1. There is a real world consisting of entities structured according to their properties and relations. Categorization of these entities is based on their properties;

2. The real world is fully and correctly structured so that it can be modeled;
3. Symbols are representations of reality and can only be meaningful to the degree that they correspond to reality;
4. The human mind processes abstract symbols in a computer-like fashion so that it mirrors nature;
5. Human thought is symbol-manipulation and is independent of the human organism; and,
6. The meaning of the world exists objectively, independent of the human mind and is external to the knower.

In essence, behaviourism was born out of a need to practice psychology as a science, and only that which is observable and measurable is of interest to behaviourist psychology, which sees knowledge as separate from knowing (Reeves and Hedberg, 2003:191). Behaviourism's influence on education appears to be at the level of invoking stimulus and reward conditioning to bring about new behavioural responses in learners, which the behaviourists deem sufficient to bring about what Frankena (1973:online) calls "desirable dispositions" in learners (Reeves and Hedberg, 2003:12; Reeves and Hedberg, 2003:192). In other words, education is a process of conditioning rather than learning (Peters, 2003:online).

Little or no attention is given by behaviourists to what they consider immeasurable, Skinner's "inner lives". The mind, or what is present in the mind (Phillips and Soltis, 1998:29), is discarded as having no influence on the practice of the enterprise of education. Apart from the reservations already expressed in this section, behaviourism also appears to suffer from the fact that it considers all factors influencing the outcome of learning to be extrinsic, leaving very little room for intrinsic motivation on the part of the learner.

Furthermore, Skinner's approach to behaviourist learning, namely the breaking down of what is to be learned into small steps and ordering them into logical sequence (Entwistle, 1988:8) seems to be at the very heart of what educationists believe to be wrong with education today, namely the deconstruction and decontextualisation of knowledge (Brown, Collins and Duguid, 1989:online; Ramsden, 1992:39; Laurillard, 1993:15-17; Herrington and Oliver, 2000:online; Herrington *et al.*, 2004:4). In 1969 psychotherapist Carl Rogers pointed out that:

We frequently fail to recognize that much of the material presented to students in the classroom has, for the student, the same perplexing, meaningless quality that the list of nonsense syllables has for us. This is especially true for the under-privileged child whose back-ground provides no context for the material with which he is confronted.

(Rogers, 1969:3)

Rogers (1969:3) goes on to say that:

Large portions of the curriculum are, for him [the child], meaningless. Thus education becomes a futile attempt to learn material with no personal meaning. Such learning is 'from the neck up'. It does not involve feelings or personal meanings; it has no relevance for the whole person.

Peters (2003:online) concludes his paper by claiming that:

It would be difficult to maintain that, in the sphere of *scientific theory*, behaviorism has advanced the understanding of behavior in any major respect.

At the end of this section it is perhaps pertinent to ask, as Phillips and Soltis (1998:30) do:

Is learning best conceived as a change in behaviour, or is something left out by this account?

As Kuhn (1970:121) points out:

... research in parts of philosophy, psychology, linguistics, and even art history, all converge to suggest that the traditional epistemological paradigm is somehow askew.

These sentiments support the opinion of this author, born out in Section 3.3: Position of the Researcher, that behaviourism's influence on tertiary education is all but a spent force. It remains for us to examine the literature for an alternative paradigm.

2.2.2 The Rationalists – learning as the result of activities of the mind

If one is to reject behaviourism as the basis for the study of education and as a guide of its practice, it is important then to embark on an exploration of the literature for alternative psychology on which to base one's epistemology. This in itself is not without its pitfalls as, according to Peters (2003:online):

In the sphere of learning, for instance, in which behaviorists evinced most interest, how much depends upon conceptual and logical relationships involved in what has to be learnt and how much depends on general empirical conditions about which psychologists reasonably test hypotheses? The work of theorists such as Jerome Bruner and Jean Piaget, who have been concerned with human learning and development in a concrete rather than a programmatic way, raises such problems in an acute form. But it is difficult to see how much progress can be made until issues of this sort are squarely faced. But to face them would involve a revolution in psychology as radical as the methodological movement which Watson himself initiated.

Perhaps the answer lies in an educational psychology that puts the “mental” and the activities of the mind back into the equation of how learning takes place, where learners “form some sort of mental structure of their knowledge” (Peters and Soltis, 1998:31). As far as education psychology is concerned the two important movements in the rationalist school of thought are cognitivism and constructivism, both with roots in cognitive psychology. In order to understand the underlying premises of cognitivism and constructivism it is necessary to delve a little into cognitive psychology.

It is, according to Green (1996:online), widely believed that the use of the word “cognitive” in psychology was coined by Jerome Bruner, and psychologists of his generation, as a means of reintroducing terms to psychology previously considered heresy as a result of the influence of behaviourist thought on psychology. However, Green (1996:online) argues that its use as a term to encapsulate things “mental” – e.g. memory and reasoning – is not supported by cognitive philosophy where the term “cognitive” is defined as dealing with statements that are “truth-evaluable”, i.e. either true or false.

Be that as it may, it seems that cognitive psychology developed out of a need to be able to study things “mental” with the same rigorous scientific method espoused by the behaviourists, which Green (1996:online) calls the “information processing approach”. This in an attempt to return the “mental” to the study of psychology, without actually embracing mentalism, the rejection of which led to the rise of behaviourism in the first place. According to Ertmer and Newby (1993c:online), cognitivists are concerned with the “far more complex cognitive processes such as thinking, problem solving, language, concept formation and information processing”

than with the simple concepts of the observable and measurable, which dominate behaviourist psychology. According to Good and Brophy, (1990:187):

Cognitive theorists recognize that much learning involves associations established through contiguity and repetition. They also acknowledge the importance of reinforcement, although they stress its role in providing feedback about the correctness of responses over its role as a motivator. However, even while accepting such behavioristic concepts, cognitive theorists view learning as involving the acquisition or reorganization of the cognitive structures through which humans process and store information.

The common thread running through cognitivist pedagogy is the premise that learners are actively engaged in their learning and the formation of their ideas as opposed to being passive receivers of a particular "truth" (Laurillard, 1993:15; von Glasersfeld, 1981:online).

It was the Gestalt [meaning "organisation" or "configuration" (Phillips and Soltis, 1998:35)] psychologists, Wertheimer, Kohler, Koffka, and Lewin, who were the first to challenge the behaviourist point of view, rejecting the behaviourist view that simple parts form a complex whole (Phillips and Soltis, 1998:35) and accepting in its place the notion that the whole is greater than the sum of its parts (Poole and Jackson, 2003:211, online). The Gestalt psychologists recognised that learning is about attempting to make meaning of the world around us by making sense of the whole and the elements that make up the whole (Phillips and Soltis, 1998:35-36).

However, it was the likes of Dewey, Piaget, Vygotsky, Bruner and Ausubel, who had the greatest impact on cognitive thought with respect to its influence on education.

John Dewey (1859-1952) was probably the first cognitive thinker to have an impact on education. Dewey outlined his philosophy in his book "My Pedagogic Creed" (Dewey, 1897:online):

I believe that the only true education comes through the stimulation of the [learner's] powers by the demands of the social situation in which he finds himself. Through these demands he is stimulated to act as a member of a unity, to emerge from his original narrowness of action and feeling and to conceive of himself from the standpoint of the welfare of the group to which he belongs. Through the responses which others make to his own activities he comes to know what these mean in social terms. The value which they have is reflected back into them.

While conceding that information could be transmitted to learners by the teacher, he believed that learners needed to engage with problems related to such information for them to learn successfully (Phillips and Soltis, 1998:39).

Dewey (1916:online) believed in a relationship between education and social life and that transmission of ideas occurred through communication, "a process of sharing experience till it becomes a common possession" through the modification of the perspectives of those involved.

That the ulterior significance of every mode of human association lies in the contribution which it makes to the improvement of the quality of experience is a fact most easily recognized in dealing with the immature. That is to say, while every social arrangement is educative in effect, the educative effect first becomes an important part of the purpose of the association in connection with the association of the older with the younger.

(Dewey, 1916:online)

Dewey emphasised the importance of the school as a community, with teachers actively participating in the activities of the community along with the learners, with the emphasis on the creation of stimulating learning opportunities, as opposed to merely imparting information to the learners (Phillips and Soltis, 1998:56).

Dewey did not shy away from the importance of thinking in learning; in fact he appears to castigate the behaviourists when he says:

The initial stage of that developing experience which is called thinking is experience. This remark may sound like a silly truism. It ought to be one; but unfortunately it is not. On the contrary, thinking is often regarded both in philosophic theory and in educational practice as something cut off from experience, and capable of being cultivated in isolation. In fact, the inherent limitations of experience are often urged as the sufficient ground for attention to thinking. Experience is then thought to be confined to the senses and appetites; to a mere material world, while thinking proceeds from a higher faculty (of reason), and is occupied with spiritual or at least literary things. So, oftentimes, a sharp distinction is made between pure mathematics as a peculiarly fit subject matter of thought (since it has nothing to do with physical existences) and applied mathematics, which has utilitarian but not mental value.

In Dewey's (1916:online) view, the:

... first stage of contact with any new material, at whatever age of maturity, must inevitably be of the trial and error sort. An individual must actually try, in play or work, to do something with material in carrying out his own impulsive activity, and then note the interaction of his energy and that of the material

employed. This is what happens when a child at first begins to build with blocks, and it is equally what happens when a scientific man in his laboratory begins to experiment with unfamiliar objects.

He appears to consider the importance of situating learning in the real world when he says (1916:online):

To realize what an experience, or empirical situation, means, we have to call to mind the sort of situation that presents itself outside of school; the sort of occupations that interest and engage activity in ordinary life. And careful inspection of methods which are permanently successful in formal education, whether in arithmetic or learning to read, or studying geography, or learning physics or a foreign language, will reveal that they depend for their efficiency upon the fact that they go back to the type of the situation which causes reflection out of school in ordinary life. They give the pupils something to do, not something to learn; and the doing is of such a nature as to demand thinking, or the intentional noting of connections; learning naturally results.

Like Skinner, Dewey was influenced by Charles Darwin's work on evolution and speculated that the ability to think and learn was a necessary evolutionary trait that contributed to the successful evolution of the human species (Phillips and Soltis, 1998:38). As a consequence, he believed that learners constantly engaged in the activity of solving problems, particularly meaningful problems, were dealing with the world around them in the manner that had proved successful for the species from an evolutionary point of view (Phillips and Soltis, 1998:38-39).

Although Dewey attempted to describe the mental processes involved in learning as a result of problem solving, he left us with little understanding of these mental processes and it was up to later cognitivists to try and unravel these processes (Phillips and Soltis, 1998:40).

The American psychologist, Jerome Bruner (b.1915), established the Center for Cognitive Studies at Harvard University in 1960, a controversial move at the time as the choice of name for the centre was considered as an act of rebellion against the prevailing behaviourist school of thought (Savage, 1991:online). Bruner's constructivist theory defines learning as an active process in which learners construct new ideas based on current or previously acquired knowledge (Kearsley, 1994d:online). He recognised learning as a social process that actively encourages

learners to select information, develop hypotheses and make decisions while integrating these experiences into their own understanding of the environment:

To instruct someone . . . is not a matter of getting him to commit results to mind. Rather, it is to teach him to participate in the process that makes possible the establishment of knowledge. We teach a subject not to produce little living libraries on that subject, but rather to get a student to think mathematically for himself, to consider matters as an historian does, to take part in the process of knowledge-getting. Knowing is a process not a product.

(Bruner, 1966:72)

Bruner's Cognitive Learning Theory is concerned with mental processes that facilitate learning and is based on categorisation of information, emphasising the formation of coding systems into which learners organise these categories. He was, as was Dewey, an advocate of discovery-orientated learning believing that this approach could help learners to discover the relationships between these categories (Kearsley, 1994d:online).

Initially Bruner knew nothing of the earlier works of Jean Piaget (1896-1980) or Lev Vygotsky (1896-1934) and it was only when their work was translated into English that the ideas of these cognitivists had an influence on Bruner and American cognitive thought.

Rejecting the behaviourist view of learning, Piaget postulated that learning – a biological function that developed as an evolutionary mechanism that contributed to human ability to cope with the environment (Phillips and Soltis, 1998:41) – occurred as the result of continuous interaction between a learner and the world. These interactions become more complex as the learner adapts to the environment (Anon-1, undated:online) and are the catalysts of construction of cognitive structures (Phillips and Soltis, 1998:42), defined as schema or mental structures employed by learners to organise their experiences by abstraction and generalisation (Anon-2, 1998:online), in the learners' mind; and of the construction of mental models, which learners use to organise concepts and operations (Phillips and Soltis, 1998:50). Construction of cognitive structures and mental models enable learners to understand and respond to their experiences within their environment (Funderstanding, 1998a:online). Piaget postulated that the building of these cognitive structures follows a specific pattern, commencing with a learner in a state of mental

equilibrium. This equilibrium is interrupted or disturbed by an event – which Piaget, like Dewey and others before him, thought of as emanating from exploration of the learner's environment (Phillips and Soltis, 1998:42) – that elicits a state of mental disequilibrium, characterised by a confusion or mental imbalance. The period of confusion is followed by a period of assimilation, during which time new perceptual, motor or conceptual knowledge is integrated into the learner's existing cognitive structure, and accommodation, during which time the development of a new or the modification of an existing cognitive structure takes place as a consequence of the new knowledge acquired during the event (Funderstanding, 1998a:online; Phillips and Soltis, 1998:45).

Piaget's approach suffers from a number of shortcomings, in particular the fact that he does not address the question of why the changes in equilibrium occur which result in the development of cognitive structures, nor does he address the question of how new concepts are formed in the absence of cognitive structures addressing these concepts in the first place (Phillips and Soltis, 1998:47–49). Furthermore, critics are concerned that Piaget's interactions occur between learner and the environment in an individualistic rather than social manner (Phillips and Soltis, 1998:55; Lave and Wenger, 1991:47).

While the works of Piaget and other early cognitivists suffered from the depiction of the learner as a "lone investigator" (Phillips and Soltis, 1998:53) – or what has come to be known as "individualization" (Lave and Wenger, 1991:47) – Vygotsky's (1896–1934) Social Development theory had a major impact on the advancement of cognitive psychology and, later, on the re-exploration of constructivist thought. This theory, based on the notion that social interactions are fundamental to the development of cognition (Kearsley, 1994e:online), postulates that learning results from a learner's interaction with others and the internalisation of that interaction. As Vygotsky (1978:57) says:

Every function in the [learner's] cultural development appears twice: first on the social level, and later, on an individual level; first, between people (interpsychological) and then inside the [learner] (intrapsychological). This applies equally to voluntary attention, logical memory, and to formation of concepts. All higher functions originate as actual relationships between individuals.

Vygotsky believed that learning activities should involve whole behaviours, stressing that learning activities should be real (situated) and not artificial or contrived so that learners could understand the need for learning. Social interactions should, according to Vygotsky, be developmental with the aim of acquiring new signs and tools (Funderstanding, 1998a:online). Vygotsky defined logics, symbolic interactions, concepts, forms of notation, signs, numbers and words – i.e. language – as tools that learners use to build their view of the world (Phillips and Soltis, 1998:59). Vygotsky also believed that learners should be sufficiently challenged for learning to take place and that learners should always be given an opportunity to develop mastery of their work (Funderstanding, 1998a:online).

Vygotsky's zone of proximal development (ZPD) is defined as:

... the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.

(Vygotsky, 1978:86)

The ZPD represents the lower and upper levels of the levels of instruction at which learners are sufficiently challenged for learning to take place.

Instruction is only useful when it moves ahead of development leading the child to carry out activities that force him to rise above himself.

(Vygotsky, 1934:212-213).

Ausubel's (b.1918) work was unaccepting of the idea of discovery learning as proposed by the early cognitivists or rote learning as proposed by the behaviourists. Instead Ausubel proposed reception learning as an alternative (Kearsley, 1994f:online and Geier, undated:online). Ausubel (1968:iv) was interested in building on what the learner already knows:

If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows.

The Merriam-Webster Dictionary Online (Merriam-Webster, 2004:online) defines the word subsume as "to include or place within something larger or more comprehensive". Thus, Ausubel's Subsumption theory postulates that learning takes

place when new ideas are linked or related to the more comprehensive, previously understood material within their cognitive structures (Kearsley, 1994f:online; Lever-Duffy, McDonald and Mizell, 2004:online). Ausubel called the process of continual transformation and reorganisation of cognitive structures as a result of the subsumption process, progressive differentiation. Ausubel proposed advanced organisers as instructional mechanisms that act as a bridge between the new material and what the learner already knows, a means of stimulating a learner's prior knowledge (Kearsley, 1994f:online; Phillips and Soltis, 1998:67).

These organizers are normally introduced in advance of the learning material itself and are used to facilitate establishing a meaningful learning set. Advanced organizers help the learner to recognize that elements of new learning materials can be meaningfully learned by relating them to specifically relevant aspects of existing cognitive structure.

(Ausubel, Novak and Hanesian, 1978:170-171)

In other words, it is important in Ausubel's mind for educators to ensure that learners have the necessary cognitive structures in order for them to be able to process the new material (Ally, 2004:9). According to Kearsley (1994f:online), Ausubel's subsumption theory incorporates the following principles:

1. The most general ideas of a subject should be presented first and then progressively differentiated in terms of detail and specificity.
2. Instructional materials should attempt to integrate new material with previously presented information through comparisons and cross-referencing of new and old ideas.

Furthermore, the following conditions must be met in order for learning to be meaningful (Barnett, 2002:online):

- the material itself must be meaningful;
- the learner must have the relevant background knowledge;
- the learner must intend to learn.

Herbert Blumer's (1900-1987) theory of Symbolic Interactionism has also played a role in shaping later thinking in education. Blumer's theory is guided by three premises, namely,

... that human beings act towards things on the basis of the meanings that things have for them ... the meaning of such things is derived from, or arises out of, the social interaction that one has with one's fellows ... these

meanings are handled in, and modified through, an interpretative process used by the person in dealing with things he encounters.

(Blumer, 1969:2)

The “things” Blumer talks about include “world-physical objects”, “categories of humans”, “institutions” “guiding ideals”, “activities of others” and “situations encountered” (1969:2). Blumer criticised scholars of his day for ignoring meaning (1969:2), instead turning to the behaviourist tradition’s preoccupation with “. . . factors used to account for [human] behaviour.” (1969:3). Blumer asserted that:

To bypass meaning in favor of factors alleged to produce the behaviour is seen as a grievous neglect of the role of meaning in the formation of behaviour.

(1969:3)

Blumer defined meaning from the symbolic interactionist point of view as “. . . arising in the process of interaction between people.” (1969:3).

In summary, the rationalists were more interested in the role of the mind in learning than in changing behaviour to bring about learning. Much of rationalist thought in the 20th century developed in response to the growing influence of behaviourism while still adhering to the principals of scientific method in an attempt to measure the activities of the mind in the learning process. The approach of the rationalists, with roots in the rationalist thought (Ertmer and Newby, 1993a:online) of the likes of Socrates, Plato and Descartes, is more a learner centred approach (Simms, 1995:online; Kanuka and Anderson, 1999:online) – or “learning centered” (Anderson, 2004:35) – where learners and learning take centre stage and learning involves the mind and mental processes, including memory, motivation and thinking, taking previous knowledge and experiences into account (Reeves and Hedberg, 2003:12; Reeves and Hedberg, 2003:192; Ally, 2004:7). According to Vrasidas (2000:7, online), echoed by Jonassen (1991:29), the underlying tenets of rationalist thought are:

1. There is a real world that sets boundaries to what we can experience. However, reality is local and there are multiple realities;
2. The structure of the world is created in the mind through interaction with the world and is based on interpretation. Symbols are products of culture and they are used to construct reality;
3. The mind creates symbols by perceiving and interpreting the world;

4. Human thought is imaginative and develops out of perception, sensory experiences, and social interaction; and,
5. Meaning is a result of an interpretive process and it depends on the knower's experiences and understanding.

Rationalist thought contributed to the development of two modern schools of thought with respect to learning, namely the cognitive scientists – who explore an information model of learning which emphasises the role of the cognitive processes that take place within an individual, and the constructivists – who are concerned with the influence of the learning environment on learners and the social aspects of the learning process, without losing sight of the cognitive processes involved in the learning.

2.2.3 The Cognitive Science Approach – information processing models of learning

The information processing approach to how learners learn sees the human brain as a computer, describing its architecture in terms of an information processor (Phillips and Soltis, 1998:75-76). The information processing approach is concerned with the role of memory in the learning process (Ally, 2004:8) – particularly the process through which information from the senses is processed and transferred from short- to long-term memory (Ally, 2004:9-10) and how that information is “indexed” and retrieved (Phillips and Soltis, 1998:77). In addition, the cognitive science approach is also concerned with individual differences with respect to learning strategy and is, thus, interested in learning styles (Ally, 2004:14), i.e.:

... how a learner perceives, interacts with and responds to the learning environment ...

Keefe and Ferrell (1990:61) define learning style or learning strategy as:

... a gestalt combining internal and external operations derived from the individual's neurobiology, personality and development, and reflected in learner behaviour.

A number of researchers have developed theories on the strategies or mental behaviours usually applied by learners, particularly when involved in conscious learning (Draper, 2000:online). Learning strategy theory is based on the assumption that individual learners have pre-determined preferences in the way they learn, with particular reference to the “environmental, emotional, sociological, physical and

psychological conditions” in which learning takes place (Wild and Quinn, 1998:75) Instructional designers, therefore, need to take cognisance of this when designing learning material (Funderstanding, 1998b:online; Wild and Quinn, 1998:75; Ally, 2004:14).

Anthony Gregorc developed a tool to determine learning styles, which he called the *Style Delineator*. This tool categorises learning styles according to two perceptual qualities, namely:

concrete – register information using the five senses; dealing with the tangible with no hidden meanings; and,

abstract – visualisation, conceptualisation, relating to the unseen, using intuition and imagination, looking for more subtle implications,

and two ordering abilities (processors), namely:

sequential – organising information in a linear, step-by-step fashion; or,

random – organise information in chunks delivered in no particular order.

(Mills, 2000:online)

Kolb's Learning Style Inventory (Ally, 2004:14) identifies two major categories of learning style, namely perception and processing. Perception refers to the sensing and absorption of information, while processing refers to the manner in which learners understand, or process the information absorbed. Kolb further categorises perception into concrete and reflective perception. Concrete perception refers to a learners' intrinsic desire to learn about their environment or aspects of their environment, while reflective perception refers to a learner's process of reflecting about what is being learned. Kolb's processing category is also further divided into two subcategories, namely, abstract conceptualisation – learners in the category are comfortable learning facts and figures, and active experimentation – learners who like to actively experiment with their environment.

However, the cognitive view of knowledge may suffer from the fact that it relies on, as Laurillard (1993:15) puts it:

... information processing models of cognition with their reliance on the metaphor of knowledge structures, or conceptual structures to describe mentalistic entities that can be changed through instruction ... does not address the reality ... that students do not transfer their knowledge across different settings, there is a problem in relating theory to practice.

Moreover, the information processing model does not address issues such as the influence of “affective factors on learning” (Phillips and Soltis, 1998:80), nor does the model address the social and interactive aspects of learning (Phillips and Soltis, 1998:81-82; Lave and Wenger, 1991:52), rather emphasising processes within the individual (Lave and Wenger, 1991:52).

A number of researchers have challenged the notion that learning styles influence learning, maintaining that good instruction will always lead to learning and that learners can adapt their learning styles to meet the requirements of the design. In fact some authors (Draper, 2000:online) go as far as saying that learners should be taught how to learn.

It is most certainly true that learning to learn makes a considerable difference to every learner: most can get better at learning, not by magically growing their IQ, but by improving their skills at learning. Furthermore it is likely that a given method of learning may allow a learner to do well at only certain kinds of material, while another learning method would be better for other types of material.

(Draper, 2000:online)

Robotham's (1999:online) widely quoted article, while not peer reviewed, challenges the learning style research as fundamentally flawed:

... the primary concern of some researchers has been financial gain, rather than the execution of robust research methodologies.

Robotham (1999) claims that:

Although it is possible to identify the learning styles of individuals, it is questionable whether such an approach is valid. Using existing inventories of learning styles, individuals are simply allocated to a narrow range of categories, containing a limited number of learning activities to which they are, in theory, best suited.

Robotham (1999) concludes that:

Higher education teaching should seek to move beyond the enhancement of performance within a narrow spectrum of activities, and consider the development of foundation skills, such as self-directed learning.

While not without its critics, it is, in the mind of this researcher, left up to the constructivism to try and address the issues raised in our attempt to identify a

pedagogy that supports an understanding of how learning takes place and that will guide the practice of learning.

2.2.4 The Constructivists – situation, contextualisation and authentication of learning in the real world, or simulations of the real world

In addition to the mental processes of the cognitivists, the constructivists see learning as a highly personalised, social activity of observation, processing and interpretation (Ally, 2004:7) situated in the context of the real world (Brown, Collins and Duguid, 1989:online; Herrington and Oliver, 2000:online) or second order representations of that world (Laurillard, 1993:25; Herrington and Oliver, 2000:online), and results from an understanding of and a response to the real world (Funderstanding, 1998a:online; Ally, 2004:7) or second order representations thereof (Laurillard, 1993:25; Herrington and Oliver, 2000:online)

From a philosophical perspective it is important to note the following because it is this very point of view that informed epistemological thought for centuries:

The philosopher of science, Hilary Putnam, has recently formulated [the epistemological problem – how we acquire knowledge of reality, and how reliable and "true" that knowledge might be] like this: "It is impossible to find a philosopher before Kant (and after the pre-Socratics) who was *not* a metaphysical realist, at least about what he took to be *basic* or unreducible assertions". Putnam explains that statement by saying that, during those 2,000 years, philosophers certainly disagreed in their views about what *really* exists, but their conception of truth was always the same, in that it was tied to the notion of objective validity. A metaphysical realist, thus, is one who insists that we may call something "true" only if it corresponds to an independent, "objective" reality.

(Von Glasersfeld, 1981:online)

It was, according to von Glasersfeld (1981:online), up to radical constructivism to:

... break[s] with convention and develop[s] a theory of knowledge in which knowledge does not reflect an "objective" ontological reality, but exclusively an ordering and organization of a world constituted by our experience. The radical constructivist has relinquished "metaphysical realism" once and for all

...

"The most fundamental trait of constructivist epistemology", according to von Glasersfeld (1981:online) is:

... that the world that is constructed is an experiential world that consists of experiences and makes no claim whatsoever about "truth" in the sense of correspondence with an ontological reality.

It was this break with philosophical convention that informed constructivist thought in education. From an epistemological perspective constructivism is, according to Fosnot (1996:ix):

... a theory about knowledge and learning; it describes both what 'knowing' is and how one "comes to know" ... the theory describes knowledge as temporary, developmental, nonobjective, internally constructed, and socially and culturally mediated. Learning ... is viewed as a self-regulatory process of struggling with the conflict between existing personal models of the world and discrepant new insights, constructing new representations and models of reality as a human meaning-making venture with culturally developed tools and symbols, and further negotiating such meaning through cooperative social activity, discourse, and debate.

Constructivist pedagogy:

... suggests an approach to teaching that gives learners the opportunity for concrete, contextually meaningful experience through which they can search for patterns, raise their own questions, and construct their own models, concepts, and strategies.

(Fosnot, 1996:ix)

According to Ally (2004:6) constructivist theorists claim that:

... learners interpret information and the world according to their personal reality, and that they learn by observation, processing, and interpretation, and then personalize the information into personal knowledge. Learners learn best when they can contextualise what they learn for immediate application and to acquire personal meaning.

In other words, constructivist learners are actively involved in their own learning, as opposed to merely responding to stimuli, using cognitive processes to make sense of their world, which is largely influenced by their own experiences, understanding and interpretation of the world (Kanuka and Anderson, 1998:59; Ally, 2004:18).

Reeves and Hedberg's (2003:192) description of constructivism sums up this focus on both the individual and the cognitive processes:

... constructivists emphasize the primacy of each individual learner's intentions, experiences and cognitive strategies ... any given learner constructs different cognitive structures based upon his or her previous knowledge and what he or she experiences in different learning environments

. . . The learner is regarded as an individual replete with pre-existing knowledge, aptitudes, motivations, and other characteristics . . .

Constructivism is certainly not without its critics. According to Osborne, (1996:53):

The failure of constructivism to recognize its own limitations has led to it enjoying a hegemony in the research community which is undeserved.

One of the major criticisms of constructivism is the fact that constructivists do not acknowledge the existence of, as Vrasidas, (2000:2, online) puts it, a “. . . real world [that] is fully and correctly structured so that it can be modeled”, particularly with respect to knowing and practice in the field of science (Osborne, 1996:53; von Glasersfeld, 1996:3). However, Vrasidas (2000:7, online) argues that constructivism does not reject the idea of a real world, but constructivist theory merely postulates that there is no single way in which this real world can become known. Von Glasersfeld (1996:4) points out that a distinction must be made between experiential validity and the philosophical meaning of truth. On the other hand it may all boil down to a question of semantics.

The literature generally identifies two branches of constructivist learning theory, namely, cognitive or critical construction and situated or social construction (Cobb, 1996:34; Vrasidas, 2000:7, online), the former concerned with the personal and the latter with the social environment. These two perspectives appear to be at odds with one another, as Cobb (1996:35) says:

Thus there is currently a dispute over both whether the mind is located in the head or in the individual-in-social-action, and whether learning is primarily a process of active cognitive reorganization or a process of enculturation into a community of practice.

However, many authors (Kanuka and Anderson, 1999:online) also acknowledge radical constructivism – with its assertion that reality is speculation and knowledge is personal, and co-constructivism or social constructivism – with its emphasis on the importance of social interaction, society and culture in learning – as important branches of constructivist psychology (Kanuka and Anderson, 1999:online). It would appear that authors recognising two constructivist branches lump radical constructivism together with cognitive constructivism – that is if they are not intimidated by the labels radical or extreme ascribed to these schools of thought

(Kanuka and Anderson, 1999:online) and ignore it completely – and social constructivism together with situated constructivism – or completely ignore the latter, as Kanuka and Anderson did in 1998, a position that they altered in 1999. In any event, it is often difficult to distinguish one from the other, except perhaps on the grounds of each position's definition of reality or truth and how this is dealt with in the learning process. Having said that, an attempt will be made to examine the aspects of all four schools of thought as part of this literature review.

2.2.4.1 *Reality, Truth and Constructivist Learning.*

Cognitive constructivists accept the objectivist view that there is a truth or a real world, however, they also accept that, while we may aspire to understand that truth or the real world we can never achieve “absolute understanding” (Kanuka and Anderson, 1999:online). This school of constructivist thought holds that knowledge construction is a personal activity taking place inside the learner's head while the learner is integrating experiences or “internal contradictions” that result from a learner's interaction with the environment (Kanuka and Anderson, 1998:60; Kanuka and Anderson, 1999:online; Vrasidas, 2000:7, online). Cognitive constructivists see knowledge construction as an ongoing or “dynamic and successive” (Kanuka and Anderson, 1999:online) process through which the learner builds on what is already known, or on what has already been learned, in order to come to a clearer understanding of a “true (or objective) world” through assimilation and accommodation (Kanuka and Anderson, 1999:online). It is generally accepted that cognitive construction draws its inspiration from Piaget's ideas on the influence of assimilation and accommodation on the building of cognitive structures (Cobb, 1996:37; Kanuka and Anderson, 1999:online).

Radical constructivism sees reality as:

... a speculation or a supposition, or – at most – a hypothetical position that is, really, just an individual's opinion. Knowledge is, essentially, a function of the workings of our cognitive structure and thus a very personal experience.

(Kanuka and Anderson, 1999:online)

Radical constructivism holds, as does cognitive constructivism, that environment and experiences are important influences on the construction of knowledge. However the radicals differ from the cognitivists in their assertion that individuals can never come

to the same understanding, in other words there can never be shared reality (Kanuka and Anderson, 1999:online), as environment and experience cannot be the same for everyone. Radical constructivists postulate that environment and experience must therefore influence the function of our cognitive structure in a unique way. As von Glasersfeld (1981;online) puts it:

Knowledge can now be seen as something which the organism builds up in the attempt to order . . . The possibilities of constructing such an order are determined and perpetually constrained by the preceding steps in the construction. That means that the "real" world manifests itself exclusively there where our constructions break down. But since we can describe and explain these breakdowns only in the very concepts that we have used to build the failing structures, this process can never yield a picture of a world that we could hold responsible for their failure.

Like cognitive constructivists, the proponents of situated constructivism postulate (Kanuka and Anderson, 1999;online) ". . . that we can know what is real – but not with certainty." Unlike the cognitivists, the situated constructivists emphasise the importance of "the activity in which knowledge is developed and deployed" (Brown, Collins and Duguid, 1989:online), paying scant attention to developing and understanding of the activities going on inside the learner's mind.

The social constructivists, sometimes known as the symbolic interactionists, are followers of Vygotsky Social Development Theory and Blumer's symbolic interactionist points of view (Kanuka and Anderson, 1998:60; Kanuka and Anderson, 1999:online). They emphasise the importance of the role of language and communities or groups, with common interests or "shared practices", in the construction of knowledge through interaction (Kanuka and Anderson, 1998:60; Kanuka and Anderson, 1999:online). In other words, as Kanuka and Anderson (1999:online) point out:

. . . knowledge is constructed in the context of the environment in which it is encountered through a social and collaborative process using language.

This school of thought postulates that humans can come to shared knowledge and understanding – "that are largely consistent with one another", though not exactly the same – through the use of language to negotiate meanings (Kanuka and Anderson, 1999:online).

While the radical constructivists may differ from their constructivist peers from the point of view of objectivity of the world, there appears little to substantially differentiate between the four schools of thought found under the constructivist banner. The distinguishing features seem to revolve around influence of early scholars and a related emphasis on mechanisms. All four schools of thought acknowledge situation, environment, interaction and communication as important factors influencing learning. For example, it may be true that the cognitivists focus more of their attention on the role of the individual in learning, but they certainly acknowledge the importance of learner interaction with the environment and the importance of social interaction and discourse in both creating and overcoming the sort of disturbances necessary to bring about learning an understanding (Kanuka and Anderson, 1999:online). For the purposes of this thesis, constructivism will be dealt with as a whole, and little attempt will be made to identify into which school of thought a particular idea or approach falls. Having said this, the author acknowledges that much of what will be dealt with in the following section falls squarely into the situated constructivist camp.

2.2.4.2 *Constructivist Thought and its Influence on Approach to Learning*

Brown, Collins and Duguid's (1989) widely quoted paper, *Situated Learning and the Culture of Learning*, appears to be the seminal thesis on the subject of constructivism, despite its "deliberately speculative" approach (Brown, Collins and Duguid, 1989:online). Much of the later research subscribed to by this researcher has, as its basis, the ideas developed by these authors. For this reason, the ideas put forward in this paper will be dealt with in some detail. The approach mooted by Brown, Collins and Duguid (1989) seems to cut across all constructivist schools of thought, emphasising both situation and enculturation as important aspects of knowledge acquisition.

Criticising didactic learning's assumption that:

... knowing is separate from doing, treating knowledge as an integral, self-sufficient substance, theoretically independent of the situations in which it is learned and used. The primary concern of schools [read universities] often seems to be the transfer of this substance, which comprises abstract, decontextualized formal concepts. The activity and context in which learning takes place are thus regarded as merely ancillary to learning pedagogically

useful, of course, but fundamentally distinct and even neutral with respect to what is learned.

(Brown, Collins and Duguid, 1989:online)

They argued that:

The activity in which knowledge is developed and deployed . . . is not separable from or ancillary to learning and cognition. Nor is it neutral. Rather, it is an integral part of what is learned. Situations might be said to co-produce knowledge through activity. Learning and cognition . . . are fundamentally situated.

(Brown, Collins and Duguid, 1989:online)

Concerned with the separation of doing and knowing (Brown, Collins and Duguid, 1989:online; Cognition and Technology Group at Vanderbilt, Learning Technology Center, 1993:75; Herrington and Oliver, 2000:online) as a result of the transfer of abstract and decontextualised concepts (Brown, Collins and Duguid, 1989:online; Herrington and Oliver, 2000:online; Laurillard, 1993:15-17) that students appear unable to apply across a range of different situations (Laurillard, 1993:15) and about the apparent understatement of the importance of the role of activity and context in the learning process (Brown, Collins and Duguid, 1989:online), Brown, Collins and Duguid (1989) set about examining the need for an alternative approach.

Examining studies dealing with the learning of language and mathematics they concluded that concepts are both situated and developed through activity. Conceptual knowledge, in their opinion, should be seen as tools in the hands of learners, whose use brings about a greater understanding of the concepts and changes the learner's view of the world (Brown, Collins and Duguid, 1989:online), "moving the learner from observer to fully functioning agent" (Herrington and Oliver, 2000:online). Furthermore, how these tools are perceived and used has a direct relationship with the social or cultural context in which they are developed and the development of such use should be done using activities authentic to this cultural context (Brown, Collins and Duguid, 1989:online), a process they refer to as enculturation.

Brown, Collins and Duguid's (1989:online) criticism of the didactic, objectivist approach centred around their observation that students in a didactic environment acquired information about the tools, but learned to use these tools through activities

governed by the culture of the school society, whose aim is for students to pass examinations – what Herrington *et al.* (2004:7) describe as the “enculturation into the practices of classrooms”. As Lave and Wenger (1991:97) put it:

The goal of complying with the requirements specified by teaching engenders a practice different from that intended.

This as opposed to learning to use the tools by participating in activities using the tools for the purpose for which they were designed (Brown, Collins and Duguid, 1989:online). Building on the metaphor of conceptual knowledge as tools in the hands of learners and the need for developing the use of these tools in an authentic manner, Brown, Collins and Duguid (1989:online) developed the concept of cognitive apprenticeships.

Cognitive apprenticeship methods try to enculturate students into authentic practices through activity and social interaction in a way similar to that evident—and evidently successful—in craft apprenticeship.

(Brown, Collins and Duguid, 1989:online)

Examining Lampert’s approach to the teaching of multiplication in mathematics (Cited in: Brown, Collins and Duguid, 1989:online), Brown, Collins and Duguid (1989:online) offer the following three important descriptions of cognitive apprenticeship:

By beginning with a task embedded in a familiar activity, it shows the students the legitimacy of their implicit knowledge and its availability as scaffolding in apparently unfamiliar tasks.

By pointing to different decompositions, it stresses that heuristics are not absolute, but assessed with respect to a particular task and that even algorithms can be assessed in this way.

By allowing students to generate their own solution paths, it helps make them conscious, creative members of the culture of problem-solving mathematicians. And, in enculturating through this activity, they acquire some of the culture’s tools—a shared vocabulary and the means to discuss, reflect upon, evaluate, and validate community procedures in a collaborative process.

It is through this process of cognitive apprenticeship or situated constructivism that:

... meanings emanate from the patterns of our individual and unique social experiences that occur in a contextualized, situated and continually changing synthesis.

(Kanuka and Anderson, 1999:online)

The Cognition and Technology Group at Vanderbilt, Learning Technology Center
(1993:77) ask us to:

... consider the experiences of graduate students who have an opportunity to work closely with an excellent mentor and a research team. First, the students usually learn in the context of meaningful research goals ... and hence know why they need to acquire new information. Second, they collaborate and make contributions by coming up with ideas, teaching other (including their mentors) about areas in which they are especially knowledgeable ... Third, they have the opportunity to experience the process of continually clarifying the revising ideas rather than simply being exposed to the end products of others' explorations. Fourth, they collectively experience the human side of knowledge acquisition and communication endeavours ... Finally, such students are helped to identify both their strengths and weaknesses and, thereby, gradually clarify their career goals.

Lave and Wenger develop the concepts of apprenticeship and of situation further by proposing legitimate peripheral participation in communities of practice as a theory of situated learning (Lave and Wenger, 1991:31). Lave and Wenger (1991:29) describe legitimate peripheral participation as follows:

By this [legitimate peripheral participation] we mean to draw attention to the point that learners inevitably participate in communities of practitioners and that the mastery of knowledge and skill requires newcomers to move toward full participation in the sociocultural practices of a community. Legitimate peripheral participation provides a way to speak about the relations between newcomers and old-timers, and about activities, identities, artefacts, and communities of knowledge and practice. It concerns the process by which newcomers become part of a community of practice. A person's intentions to learn are engaged and the meaning of learning is configured through the process of becoming a full participant in a sociocultural practice. This social process includes, indeed it subsumes, the learning of knowledgeable skills.

Lave and Wenger reject learning as simply internalisation, where knowledge is either "discovered", "transmitted" or "experienced in interaction", as not considering "the nature of the learner, of the world, and of their relations" (1991:47). Rather they see learning as a social practice of:

... increasing participation in communities of practice that concerns the whole person acting in the world.

(Lave and Wenger, 1991:49, 53)

Lave and Wenger (1991:121) see communities of practice – the custodians of knowledge of a particular social community – as central to the theory of social practice, which includes learning but is not exclusively about learning. They see

learners as legitimate peripheral participants in a community, as apprentices of that community, as they move towards becoming full practitioners within that community. A new-comer becoming an old-timer within the community of practice as knowledge, skill and discourse develop (Lave and Wenger, 1991:122). In the development of the notion of learners serving an apprenticeship, Lave and Wenger (1991:93) recognise the importance of actively engaging in practice as a catalyst for learning, stressing, in particular, the importance of interaction between learners and their peers and between learners and expert opinion and of learning to talk the language of the community (Lave and Wenger, 1991:103). What is of particular interest to constructivists is the Gestaltist notion that the sum of the knowledge within such a community is greater than the knowledge of the members of that community (Johnson, 2001:49), with individual and collective knowledge supporting each other in the quest to expand knowledge through the sort of interactions or collaborations discussed in the previous section, facilitated by the instructor in the role of moderator, coach and mentor (Johnson, 2001:49).

Critics of situated learning argue that situating learning in contexts alone does not promote abstraction of knowledge by students from one context to another (Wild and Quinn, 1998:76-77). This is, according to Laurillard (1993:23-29) particularly so in the acquisition of what she calls academic knowledge and which she believes requires a level of understanding that cannot be acquired merely by situating the learning in a particular context.

Be that as it may, the process of examining the literature with respect to pedagogical paradigms has brought us to the point where a choice regarding pedagogical support for this study has to be made. Ultimately this choice becomes a personal issue as if one could present irrefutable evidence in support of a particular paradigm, then this debate would not be necessary. I refer the reader to Section 3.3: Position of the Researcher where I allude to my experiences in both instructivist and constructivist learning environments. These experiences that have led me to the position that I currently hold, which is that constructivist informed learning environments hold the key to improving learning through the promotion of deep learning strategies amongst students.

2.3 Theory into Practice – requirements for the development of a constructivist-informed academic learning environment

The role of instructional design and instructional designers is one of (Smith and Ragan, 1999:12):

... translating principles of learning and instruction into specifications for instructional materials and activities.

It is the contention of the author that the interaction between the learner and Frankena's (1973:online) "desirable methods" should be built on sound pedagogical principles and that these principles should guide the development of such "desirable methods". As will be established in Section 3.3: Position of the Researcher, the author subscribes to constructivist pedagogical principles. It will be these principles that will guide the process of translating pedagogy into specifications (Smith and Ragan, 1999:12) in search of a principled teaching strategy (Laurillard, 1993:94) in an academic learning environment. Song *et al.* (2004:67) found that students identified instructional design, not only from a technology point of view, but also from the point of view of goals, objectives and learner expectations (2004:69), as one of the most important factors as being helpful for online learning.

In this section I examine the requirements of constructivist learning environments and then use these guidelines to inform the design of the online learning environment envisaged for the development of the Physiology course that forms the basis for this study.

Constructivist learning environments should recognise that learning is an active process; therefore learners should actively participate in learning activities with a high level of processing, leading to personalised meaning (Ally, 2004:18), and that these activities should be rich and authentic in nature, situated within the context of the information being presented (Lave and Wenger, 1991:95; Ertmer and Newby, 1993d:online; Herrington and Oliver, 2000:online; Vrasidas, 2000:8, online), complex, unstructured (Ertmer and Newby, 1993d:online; Herrington and Oliver, 2000:online), and inconsistent (Kanuka and Anderson, 1999:online), leading to the sort of cognitive disturbances and disequilibrium that cognitive constructivists

postulate as important in bringing about learning (Fosnot, 1996:29; Kanuka and Anderson, 1999:online).

Learners need to apply their learning to practical situations that facilitate personal interpretation and relevance (Ertmer and Newby, 1993d:online; Ally, 2004:18-19), what Herrington and Oliver (2000:online) refer to as articulation and authentic assessment (Kanuka and Anderson, 1999:online).

Constructivist learning environments should facilitate learner construction of knowledge, and collaborative and cooperative (social) learning of a problem-solving and problem-setting nature should be encouraged in order to facilitate such construction, allowing learners to develop and use their metacognitive skills and to draw on the strengths of their peers (Fosnot, 1996:29-30; Kanuka and Anderson, 1999:online; Herrington and Oliver, 2000:online; Ally, 2004:19) as well as providing “multiple roles and perspectives” (Ertmer and Newby, 1993d:online; Kanuka and Anderson, 1999:online; Herrington and Oliver, 2000:online) to the learners in order to achieve meaning. As Lave and Wenger (1991:93) point out:

The effectiveness of the circulation of information among peers suggests . . . that engaging in practice . . . may well be a *condition* for the effectiveness of learning.

In constructivist learning environments, learners need to be given control over the learning process by participating in the goal setting process with the instructor/facilitator (Ertmer and Newby, 1993d:online; Kanuka and Anderson, 1999:online; Ally, 2004:19), even to the extent of raising their own questions hypotheses and testing them for validity (Fosnot, 1996:29).

Learners in a constructivist learning environment must be given the opportunity to reflect on their learning as part of the process of internalisation of information (Ertmer and Newby, 1993d:online; Fosnot, 1996:29; Kanuka and Anderson, 1999:online; Herrington and Oliver, 2000:online; Ally, 2004:19-20), or as Lave and Wenger (1991:111) put it:

As opportunities for understanding how well or poorly one's efforts contribute are evident in practice, legitimate participation of a peripheral kind provides an immediate ground for self evaluation. The scarcity of tests, praise, or

blame typical of apprenticeship follows from the apprentice's legitimacy as a participant.

Learning should be meaningful to the learners and relate to learners (Ally, 2004:20). In this respect Herrington and Oliver (2000:online), and others (Ertmer and Newby, 1993d:online; Fosnot, 1996:30) go a step further, claiming that constructivist learning environments should be authentic within the context of the way the knowledge is used in the real world, i.e. relevant and appropriate to a variety of situations.

Learning in a constructivist learning environment needs to be interactive in order for learners to develop meaning and understanding (Kanuka and Anderson, 1999:online; Ally, 2004:20). Herrington and Oliver (2000:online) and Kanuka and Anderson (1999:online) further add that coaching and scaffolding needs to be provided when necessary. Wild and Quinn (1998:76) point out that placing the learner in a "sea of content" without the necessary tools and supports will not result in learning. It is important for instructional designers to bear in mind that where their expectations of learner control are high, i.e. the learning environment is unstructured, places high metacognitive demands on these learners. Learner control with support (coaching, scaffolding "guided discovery") is more likely to prove effective than total learner control, such as unstructured browsing.

Finally, learners in a constructivist learning environment should have access to expert performances – what Lave and Wenger (1991:110) call "mature practice" – in a community of practice (Lave and Wenger, 1991:121), as a learner becomes part of that community (Lave and Wenger, 1991:111).

2.3.1 Authenticity in Constructivist Learning Environments

We have seen in that authenticity of tasks is one of the cornerstones of constructive learning environments. Herrington *et al.* (2004:11-13) list ten characteristics of authentic activities:

1. Authentic activities have real world relevance – and should match the real-world tasks of professional practice;
2. Authentic activities are ill-defined, requiring students to define the tasks and sub-tasks needed to complete the activity – problems are ill-defined

- and open to multiple interpretations so that learners need to define the tasks and sub-tasks necessary to complete the main task;
3. Authentic activities comprise complex tasks to be investigated by students over a sustained period of time – i.e. over days, weeks or months, requiring investment of time and intellectual resources;
 4. Authentic activities provide the opportunity for students to examine the task from different perspectives, using a variety of resources – both theoretical and practical perspectives;
 5. Authentic activities provide the opportunity to collaborate – both within the course and with the real world;
 6. Authentic activities provide the opportunity to reflect – enabling learners to make choices and reflect on their learning both individually and socially;
 7. Authentic activities can be integrated and applied across different subject areas and lead beyond domain-specific outcomes – i.e. encouraging interdisciplinary perspectives and enabling diverse roles and expertise;
 8. Authentic activities are seamlessly integrated with assessment – in a manner that reflects the real-world;
 9. Authentic activities create polished products valuable in their own right rather than as preparation for someone else – i.e. the creation of a whole product; and
 10. Authentic activities allow competing solutions and diversity of outcome – i.e. allow a range and diversity of outcomes open to multiple solutions of an original nature.

Although this list of characteristics was published after the learning environment that forms the basis of this thesis had been developed and implemented, it is not dissimilar in intention from, and in all likelihood developed out of, the list of nine features of situated learning environments described in Herrington and Oliver (2000:online) which was used to inform this study. According to Herrington and Oliver (2000:online) authentic learning environments should:

1. Provide authentic contexts that reflect the way knowledge will be used in real life;
2. Provide authentic activities;
3. Provide access to expert performances and the modelling of processes;
4. Provide multiple roles and perspectives;
5. Support collaborative construction of knowledge;
6. Provide reflection to enable abstraction to be formed;
7. Provide articulation to enable tacit knowledge to be made explicit;
8. Provide coaching and scaffolding by the teacher at critical times; and
9. Provide for authentic assessment of learning within the tasks.

2.3.2 Interaction in Constructivist Learning Environments

Wagner (1994:8) defined interaction as:

... reciprocal events that require at least two objects and two actions. Interactions occur when these objects and events mutually influence one another. An instructional interaction is an event that takes place between a learner and the learner's environment.

The importance of interaction in education has been recognised for a long time and notes that interaction cannot be separated from the situation in which it occurs (Vrasidas, 2000:1, online). It is also recognised that some form of interaction is necessary to promote the learning process, with efficacy of interaction increasing in proportion to the control that individual learners have over the extent, form and level of these interactions (Sutton, 2001:224, online).

Sutton (2001:230-231) proposes that interaction positively influences student achievement and student attitudes, influencing students' perceived learning and course satisfaction. However, Sutton (2001:224) believes that not all students need to interact directly in order to benefit from that interaction. These students tend to cognitively process content vicariously by observing, absorbing and processing the ongoing interactions between other role players in the learning environment.

Sutton (2001:232) identifies four categories of learners with respect to how they interact, namely:

- Direct – learners who interact directly with peers and the instructor;
- Vicarious – learners who actively process the interactions of others;
- Actors – learners who participate unilaterally regardless of the reactions or comments of others; and
- Non-actors – learners who do not participate in the communication process.

These distinctions become particularly important when interaction is used as an assessment tool which, as we will see later, often happens.

Moore (1989:2), identifies three levels of interaction, namely:

- Learner-learner interaction;
- Learner-teacher interaction; and,
- Learner-content interaction.

Hillman *et al.* (1994:32-33), added a fourth interaction level, namely learner-interface interaction. They argue that with technology's increasing importance as the medium facilitating communication between learner and teacher, learner and content and between learners, the importance of interaction with the interface cannot be overlooked Hillman *et al.* (1994:33). Ally (2004:20) adds a fifth level of interaction, namely learner-support interaction. This fifth level could, according to Ally (2004:22) involve a combination of any one of the other levels on interaction in order for the learner to satisfy the need for support.

In a paper presented to the ITFORUM in 2002 Anderson (2002:online) argued that a high degree of interaction in at least one interaction level, even at the expense of interactions at other levels, results in a satisfying educational experience for the students and "sufficient levels of meaningful learning taking place". Anderson (2004:43) stresses the importance of interaction in bringing about the learning communities or communities of practice essential to constructivist learning and cognisance needs to be taken of this in designing instruction.

2.3.3 Assessment in Constructivist Learning Environments

"The commoditization of learning engenders a fundamental contradiction between the use and exchange values of the outcome of learning, which manifests itself in conflicts between learning to know and learning to display knowledge for evaluation. Testing in schools and trade schools (unnecessary in situations of apprenticeship learning) is perhaps the most pervasive and salient example of a way of establishing the exchange value of knowledge. Test taking then becomes a new parasitic practice, the goal of which is to increase the exchange value of learning independently of its use value.

(Lave and Wenger, 1991:112)

A grade is an inadequate report of an inaccurate judgement by a biased and variable judge of the extent to which a student has achieved and undefined level of mastery of an unknown proportion of an indefinite material.

(Dressel, 1983:12)

The pessimistic comments of Dressel (1983) and Lave and Wenger (1991) are certainly not encouraging. While teaching practices may have benefited from a change in approach to teaching and learning, assessment practice remains, to all intents and purposes, fixated with its role as gate keeper, despite the best efforts of a number of researchers. Assessment practices contribute to sustaining the gap between knowing and doing, and the presentation of knowledge independent of context (Kings, 1994:online). It is not surprising, then, that the form assessment takes influences the students approach to their learning (Hodgman, 1997:online). Moreover, assessment often has the effect of preventing students taking responsibility for their own learning (Hodgman, 1997:online).

Kings (1994:online) points out that if assessment is to be meaningful it should in some way reflect the practice of the profession, vocation or practice being assessed, while at the same time giving learners the opportunity to demonstrate their knowledge and skills (Rovai, 2000:3), reflecting the association between intended, taught and tested outcomes (Rovai, 2000:3). Moreover, assessments need to consider the strengths and diversity that learners bring to their learning (Rovai, 2000:3). Sound assessment strategies should make use of a number of diverse assessment tasks rather than the traditional select-response assessment, which are neither authentic nor performance-orientated (Rovai, 2000:3).

It is, according to Hodgman (1997:online) important that students become involved in the design of assessment criteria. Brown *et al.*, (1994:online) suggest that students should be involved in discussing, negotiating and setting assessment criteria at the outset. They argue that involving students in the assessment process is instrumental in their developing the ability to make judgements about themselves and their work and the work of others (Brown *et al.*, 1994:online).

Platt (2000:online) and Rovai (2000:6), distinguish between formative assessment, which should be part of the learning process and should encourage student reflection of their work and act as a motivator; and summative assessment, which evaluates the outcomes, should contribute to the final mark assigned to the task.

The design of assessment strategy needs, therefore, to play a key role in the learning process, reflecting, as closely as possible, authentic practice in the real world. Students need to be given opportunities to interact amongst themselves and with discipline experts, as well as be given the opportunity to reflect on their understanding and to modify their understanding as a result of their reflection (Anderson, 2004:37-38). Assessment in constructivist learning environments should encourage learners:

... to take responsibility for their own learning, to be autonomous thinkers, to develop integrated understandings of concepts, and to pose – and seek to answer – important questions.

Having examined the requirements it is now necessary to examine the literature for ideas of practical implementation of learning environments that attempt to meet these requirements. It is important to note, as Herrington and Oliver (2000:online) point out that:

There is no contention that formal instruction should be abandoned in favour of context-dependant strategies that are learnt “on the job”. Rather the implication is to determine the pedagogical significance of the findings and promote appropriate and effective classroom techniques and practices to foster meaningful learning.

2.4 How Technology can Help – of grocery trucks and the quality of produce

The linear nature of this document implies that a decision was taken with respect to pedagogy and then attention was given to delivery, at which point the use of computer-mediation was considered. In fact in the development process of the author of this thesis the use of technology was first considered in order to solve a particular problem, which resulted in a search for suitable philosophy to support the use of technology. In fact the two appear to go hand in hand with technology being the medium that allows for the development of the sort of constructivist learning environments that can bring about deep learning in higher education contexts, where issues such as class size have often mitigated against the use of constructivist pedagogy. Why is it important to consider the role of pedagogy in the use of technology in online learning? Nichols (2003:online) explains that:

It is unlikely that eLearning practice will continue to evolve unless the theoretical underpinnings of eLearning are explored and debated, providing a wider platform and a common philosophy for eLearning development.

Nichols (2003:online) goes on to hypothesise that:

The choice of eLearning tools should reflect rather than determine the pedagogy of a course; *how* technology is used is more important than *which* technology is used.

So, now that issues of pedagogy, epistemology and the requirements for constructivist learning environments have been dealt with, with respect to this thesis, the question of medium must be considered. This question has been subject to often heated debate since Thorndike's time (Clark, 1983:online). The pro-media camp claim that mode of delivery of educational material or educational interventions does, indeed, influence learning, while the anti-media camp claim that choice of media has no measurable, long-term influence on learning, claiming instead that the adoption of a particular mode of delivery is usually accompanied by other changes in approach that masks measurements (Clark, 1983:online). While this debate is important and cognizance should be taken of research findings from both sides, it is the contention of this researcher that computer and World Wide Web technologies do, in fact, have an important role to play in a modern educational environment as they have the ability to support a fresh approach to learning, which was more difficult to achieve prior to the invention of these technologies. However, we should never lose sight of the fact that technology mediated learning is a subset of learning in general (Anderson, 2004:35) and it should be treated as such. This section will deal specifically with computer and World Wide Web technologies in constructivist learning environments.

The Cognition Technology Group at Vanderbilt Learning Technology Center (1993:71) point out that while

... the availability of additional media does not guarantee more effective learning

employment of computer and World Wide Web technology presents exciting opportunities to improve learning.

According to Oliver (1998:online):

The value of using technology in forming sustaining learning partnerships with students is that it has not only the capability to provide for many different types of learning activity, it also has the capacity to sustain the forms of communication needed to maintain the partnership.

The sort of learning activity that Oliver (1998:online) is alluding to includes:

. . . flexible modes of content presentation and delivery; situated and contextualised presentation of content and information; multiple media sources; interactive and engaging learning settings; communicative elements to support the independent learner; collaboration, communication and cooperation between learners; place and time independence for learning.

2.4.1 Computer-mediated Communication

Probably the most important role technology plays in support of constructivist education is in computer-mediated communication because of the hugely important role communication in its many guises plays in constructivist learning environments. Romiszowski and Mason (1996:online) define computer mediated communication as a:

. . . system for information flow that enables participants to communicate and interact with each other over time.

Picciano (2002:24) reports that, while interaction in a face-to-face environment tends to be linear, interaction in online learning environments are more multi-dimensional, with a number of threads being sustained simultaneously and interaction occurring in a number of directions, both teacher-learner and teacher-teacher.

Computer mediated communication can take a number of forms, including email, newsgroups, list serves, online chats, bulletin boards, asynchronous discussions and computer conferencing, as well as streaming audio and video (Sutton, 2001). Sutton (2001:229, 234) goes on to identify one of the strengths of computer mediated communication as its ability to act as an equaliser.

Oliver (1998:online) emphasises the importance of technology as a means of supporting the communication required to sustain partnerships in teaching and learning. Certainly there is evidence that students perceive computer mediated

communication as social environments that support interpersonal interaction (Gunawardena and Zittle, 1997; Rourke and Anderson, 2002:online).

However, according to Rourke *et al.* (2001:online), the strength of computer mediated communication goes beyond simply facilitating social interaction; its strength lies in its ability to sustain high levels of learner-learner and learner-teacher interaction. Rourke *et al.* (2001:online), postulate that the Community of Enquiry Model of Teaching and Learning developed by Garrison *et al.* (2000):

... capitalizes on the ease and abundance of interaction possible with media such as computer conferencing, to promote deep and meaningful learning.

The Community of Enquiry Model of Teaching and Learning relies on the development of a cognitive presence, a social presence and a teacher immediacy, all of which are essential aspects of the learning environment (Garrison *et al.*, 2000:87, 88, online) and can be maintained in a computer mediated communication environment in support of the learner's educational experience (Garrison *et al.*, 2000:96 online). Drawing on the literature, Garrison *et al.* (2000:93, 95, 96, online) maintain that:

- students adopt a communication style more in keeping with essay writing;
- students develop strategies to overcome the lack of visual cues through the adaptation of their language and writing and through the use of signifiers such as emoticons;
- participation of teachers, tutors or facilitators significantly increases the sort of student activity important to critical or higher order thinking;

all of which positively affect the educational experience.

Garrison *et al.* (2000:103, online) conclude by saying that computer conferencing:

... appears to have considerable potential for creating an educational community of inquiry and mediating reflection and discourse.

One of the issues concerning online interaction and communication is the fact that a number of students "lurk" in online discussion forums. However, Sutton (2001:233) believes that this is not as serious an issue as lurking students tend to feed off the interactions of others, absorbing vicariously the activities going on around them.

However, Picciano (2002:24) does warn of information overload in an online interactive environment.

2.4.2 Computer-mediated Learning Environments

It is, however, the view of a number of authors that computer and World Wide Web technology can support more than collaboration, communication and interaction, although these processes will always be considered central to online learning environments. The Cognition and Technology Group at Vanderbilt, Learning Technology Center speaks of the development of problem-rich authentic macrocontexts where students can communicate, collaborate, share experiences and collectively generate knowledge (Cognition and Technology Group at Vanderbilt, Learning Technology Center, 1993:78). Examples of the type of environment developed by this Group include an adult literacy project in which adult learners either select their own contexts or are exposed to contexts with particular meaning to the group, while interacting with technology (Cognition and Technology Group at Vanderbilt, Learning Technology Center, 1993:79); an inter-disciplinary literacy project involving school learners in which learners not only acquire literacy skills but investigate the period in which the literature is set both from an historic and a sociological point of view, while interacting with technology – in some instances developing their own interactive multimedia in the process (Cognition and Technology Group at Vanderbilt, Learning Technology Center, 1993:79-80); and, a problem-solving project dealing with “complex, generative problem posing and problem solving (Cognition and Technology Group at Vanderbilt, Learning Technology Center, 1993:81) designed to assist students to understand the interdisciplinary nature of knowledge, supported by technology (Cognition and Technology Group at Vanderbilt, Learning Technology Center, 1993:81).

Kanuka and Anderson (1999:online) provide examples of learning environments that include online debates, case studies and brainstorming sessions, all supported by computer-based technology. Owston (1997:online) describes a course on protein structure that employs web-based interactive material to disseminate information regarding protein structure to students. Included in this project was an area for online

discussions where students and subject experts could meet and interact and an area where groups were able to prepare and publish the results of their activities.

Herrington and Oliver (2000:online) talk of computer-based representations of microworlds and simulations, or the development of what Laurillard (1993:25) calls second order nature of learning in higher education, situated in real-world contexts. Herrington and Oliver (2000:online) developed a learning environment for pre-service mathematics teachers in which they used technology to immerse the students in content representative of an authentic teaching environment. The tasks to be undertaken by the students were complex and presented to the students realistically within the context of the authentic environment, requiring the students to “play” the role of teachers in a school. Students presented reports to their class, which were evaluated by their peers according to specific criteria, as well as by the lecturer. As a result of this study Herrington and Oliver (2000:online) underline the importance of collaboration insofar as students:

... benefit from the opportunity to articulate, reflect and scaffold with a partner, and that they will seek these opportunities covertly if they are not available by design.

Furthermore, Herrington and Oliver (2000:online) found that the students in this study placed great store on the authentic context of the learning, as opposed to the “traditional” style of content delivery and that students interacted with one another out of necessity in order to complete the task, rather than as a result of any planned instructional design.

Critics of the use of this approach in an online learning environment are concerned that creating online representations of authentic environments further removes learners from these environments (Herrington and Oliver, 2000:online). However authors, such as Laurillard, 1993:5 stress that:

Academic learning is different from other learning in everyday life because it is generally not directly experienced, rather it is mediated by the teacher.

and, thus:

... accepting that technology can be used without sacrificing the authentic context which is such a critical element of the model [of situated learning]”

(Herrington and Oliver, 2000:online)

Interestingly enough the common theme in all these examples puts the learner, to a greater or lesser extent, in the role of producer or creator of knowledge as opposed to a recipient of knowledge, which, in the view of Hedberg (undated:online) requires learners to take an active part in the process. In this way, the technology is used not only as a content delivery medium but, more importantly, as a facilitator of the learning process.

What is of interest is that most of the examples above could have been achieved without the use of technology. Technology merely assisted the designer to effectively create the learning environment, which fits in with this researcher's understanding of the role that technology can play. In the final analysis perhaps the greatest role that technology will play, and has played, is in affording teachers the opportunity to focus on learning through the relatively simple creation of rich learning environments rather than teaching, i.e. as an agent of educational change.

2.5 But What of the Students?

We talk about student-centred learning environments and this study is particularly interested in student perceptions of, and performance in the learning environment resulting from this study of the literature. Interestingly enough it appears that perception and performance may well be interlinked as:

... perceptions may be the catalysts for continuing to pursue course work and other learning opportunities.

(Picciano, 2002:21, online)

Hill *et al.* (2002:384) see the development of communities in distance education scenarios as important in countering the high drop-out rate experienced in distance learning environments, usually between 30% and 50%. Picciano (2002:22, 23, online) reports that it is widely accepted that there is a high degree of correlation between both the quantity and quality of interaction and student satisfaction. A contention supported by Gunawardena and Zittle (1997:19) and Hong (2002:279). This researcher can certainly attest to the feeling of isolation in a traditional distance education course taken in the early 1970s, which contributed to that course not being

completed, and the incredible sense of community that existed as a result of technology-mediated communication when taking the course-work part of this Masters programme at a distance.

Using an online course in education administration for graduate students as his experimental environment which was highly dependent on teacher-learner and learner-learner interaction for its completion and to encourage a sense of community and social presence amongst the participants (Picciano, 2002:27, online), Picciano (2002:28, online) found that there was a strong correlation between student perceptions of their interaction and their perceptions of the quality and quantity of their learning. He also found that, while the level of interaction had no bearing on the examination results of the students participating in the course, he found a positive correlation between student interaction and the results of written assignments submitted during the course (Picciano, 2002:30, online). A similar situation was found when measuring student perceptions of social presence and student performance (Picciano, 2002:31, online).

The findings of Picciano's (2002) study are not dissimilar from the findings of the study by Hong (2002). Hong (2002:268) found that, while students were satisfied with their learning experiences in a web-based course, there was no relationship between that satisfaction and student achievement (Hong, 2002:277). Of interest here is the fact that Hong (2002:277) did find a correlation between student satisfaction and the initial computer skills of the students – an important consideration when designing online courses.

Prammanee (2003:online) found a high level of satisfaction experienced by learners in an online environment, despite limited interaction with peers, however, participants did cite limited interaction as a concern.

In light of the importance of interaction and collaboration in building a sense of community, Song *et al.* (2004:69) suggest that:

... there is a need to work with learners to assist them with establishing community or feelings of connection in online contexts. Integrating strategies for community building into design of the course may assist with this effort.

However, a word of caution. It has been noted (Passmore, 2000:online; Smith, 2002:online) that students in an online environment often perceive these environments negatively because they require more interactivity than classroom-based learning environments and because students perceive technology as a hurdle that needs to be overcome in order to access the learning environment itself. Some resistance to any change is inevitable (Tam, 2000:online).

Finally, a word of warning regarding shovelware, a pejorative term coined to describe text-heavy content dumped online without much thought given to its usability or interactivity, often the result of attempting to move classroom learning onto the web. Shovelware merely requires of students to turn electronic pages and pays scant attention to interactivity (Passmore, 2000:online). In contrast, Herrington *et al.* (2002) found little resistance from students engaged in authentic learning environments and the resistance that was found was generally related to technology issues.

The scene has now been set. The literature has been consulted in order to draw on the experiences of others in a technology-mediated learning environment. It is now time to put into practice what has been gleaned from the literature in order to establish how students at the University of the North react to constructivist-informed, technology-mediated learning environments. In the next section the course that formed the basis of the study is described.

2.6 The Study

A course in Physiology offered at the second year level was redesigned employing computer- and Internet-based technologies in support of constructivist principals in general and authentic learning environments in particular in the delivery of the course.

2.6.1 Assumptions

It was assumed that the redesign of this second year course in Physiology would have a positive influence on student satisfaction with the course and would not

negatively impact on student performance. It was also assumed that, given the students' background from both an educational experience and a technology experience point of view, students would experience difficulties with the approach to the course and with the use of technology.

It is important at this stage to describe the course as offered prior to implementation of computer mediation in support of a principled teaching strategy in order for the reader to understand how this course differed from the course implemented with the help of computer- and internet-based technologies.

2.6.2 The Course – PLGY232 – 1997 to 2001

What follows is a description of the structure of the course in question, prior to the introduction of the computer-mediated course as describe to the author by the lecturer concerned. The academic year consisted of 4 six-week modules, two per semester. In order to fulfil the requirements of the first half of the third module of the academic year, PLGY232, students were instructed to research, present and defend their results on an aspect of the course set by the lecturer. Students were divided into groups, usually of 5 or 6, and each group was given a unique topic to consider. Topics were presented in a "traditional" manner, i.e. they covered an aspect of human physiology that was covered in the course, such as the cause of embolisms. This was done in order to enable the academic staff to cover the voluminous material that needed to be dealt with during each module. It is important to note that this course did not make up the entire module PLGY232. It represented the first half of that module.

The student groups were given three weeks in which to research, present, defend and submit the topic. Resources were made available to the students in the form of the course handbook, a comprehensive document compiled by academic staff members within the discipline. Because of the impoverished background from which most students entering this institution are drawn; and the fact that there is a strong resistance amongst the student body to the purchase of any additional resources for their studies, there is a poorly developed tradition of acquiring prescribed textbooks on this campus. It is interesting to note that this trend is not limited to students at this

institution. According to Gilbert (2000:online), students in the United States are less inclined to purchase textbooks, with more than 30% of students not purchasing textbooks in 2000 as opposed to less than 10% in 1995. Students are encouraged to use the University library.

The results of the students' research was written up and presented orally to a group of their peers and a panel of academic staff members. On completion of the oral presentation the class was given an opportunity to ask questions of the presenting group. In an attempt to ensure participation by all group members these questions were fielded by members of the group other than the student elected to present the results. There was no other mechanism for ensuring that all members of the group participated in the task.

A panel of experts, comprising the academic staff members who are specialists in the particular discipline, undertook the assessment of the presentations. This panel judged the quality of the questions and the quality of the answers given – and graded the learners accordingly. Discussions were entered into at the end of presentations and any misconceptions were dealt with, either directly through explanation by academic staff members or by requiring the students to undertake further research in a particular direction. The students were given an opportunity after the presentation to amend their written submission in light of these discussions. The academic staff members within the discipline graded students on their written submissions. These written submissions were then copied and distributed to all members of the class and form part of the material available for studying for examinations, along with lecture notes and the course handout. The students themselves played no part in the grading process of either the oral or written submissions.

The results obtained by the students participating in this exercise went towards their practical mark for the module; the practical mark contributed 30% towards the total module mark. The students were informed of this beforehand. This fact becomes important when considering student performance in the course researched in comparison with student performance in previous years, as will become evident in Section 3.4: Data Collection and Section 3.5: Data Analysis.

2.6.3 The Course – PLGY 232 – Presented in 2002

In 2002 the course described above was redesigned to incorporate computer- and Internet-based technologies. The object of this redesigning exercise was to attempt to develop an authentic learning environment based on the work of Herrington and Oliver (2000:online), informed by the idea of cognitive apprenticeship proposed by Brown, Collins and Duguid in 1989 and Lave and Wenger's (1991) notion of community of practice, that encouraged the sort of interactions that Moore (1989), Sutton (2001), Hillman *et al.* (1994) and Ally (2004) describe as positively influencing student attitudes and student performance, while taking cognizance of assessment strategies described in Section 2.3.3: Assessment in Constructivist Learning Environments, in order to meet Laurillard's (1993) requirements for a principled teaching strategy.

What follows is a description of the redesigned course and its implementation.

Seventy-five second year Physiology students participated in the course, which commenced at the beginning of the second semester on 22 July 2002. The class gathered in one of the general purpose computer laboratories on the university campus. The class met twice weekly, on Mondays and Wednesdays for a period of three hours and the course would last for three weeks. As in the previous year, this course represented half of the module called PLGY232.

Before commencement of the course, students were given an in-depth introduction to the course and the approach to be used.

2.6.3.1 *Student Orientation to the Course*

Students were introduced to the online course delivered via the WebCT Learning Management System. They were shown how to access the site via Microsoft Internet Explorer and how to log on to the course. The class was given a guided tour of the course, commencing with a section detailing the course approach. In this section, students were introduced to the requirements of the National Qualifications Framework of the South African Qualifications Authority (undated) that specifies

eight critical or generic outcomes required from education and training in South Africa. These outcomes are:

- Identifying and solving problems (critical thinking skills);
- Working together in groups or teams;
- Organising and managing oneself;
- Collecting and handling information;
- Communicating effectively;
- Using or applying science and technology;
- Demonstrating an holistic world view; and
- Applying professional and social life skills.

Students were informed that the course they were about to embark on was designed in an attempt to meet not only the specific outcomes of the discipline, but also these generic outcomes, requiring learners to take responsibility for their own learning.

As part of the course orientation process, students were then introduced to the participants, other than themselves; the lecturer in charge of the course, Dr Pieter Mulder, Mr EV Malueleke, lecturer in Physiology, this researcher as course facilitator and three honours students from the Aquaculture discipline, who had participated in a similar course in aquaculture and were, therefore, familiar with the approach. The aquaculture honours students acted as teaching assistants. These teaching assistants had also successfully completed a course in physiology as undergraduate students before commencing with their Honours programme. This group also made up the subject experts.

Students were then asked to divide themselves into groups.

2.6.3.2 *Groups*

Students divided themselves into 12 groups of 6 students each, with three groups being 7 students strong. No criteria were used in this process and students were able to choose their group mates as they saw fit. However, the groups were informed that participation in the course required a degree of computer literacy and they were advised to ensure that at least one group member was reasonably computer literate, if possible. Each group member was assigned one of the following responsibilities by the rest of the group:

- Group Leader;
Responsible for overseeing group performance
- Researcher - Internet;
Responsible for mastering search techniques on the Internet
- Researcher - Library;
Responsible for finding books and journals on the subject in the library
- Scribe;
Responsible for mastering MS Word and writing the document
- Presenter;
Responsible for mastering MS PowerPoint and compiling the presentation
- Assessor;
Responsible for overseeing that the assessment tasks were completed.

Once responsibilities had been decided upon, students with common functions within their groups were brought together to discuss their particular function and what was expected of them.

Group leaders were advised that their responsibility was to co-ordinate the group activities and to develop and implement an action plan in conjunction with group members in order to ensure that the tasks set were accomplished.

Internet Researchers were given a short course in the use of the Internet and pointed to a number of online resources dealing with Internet searches for support, namely:

- Bare Bones 101: A basic tutorial on searching the web – <http://www.sc.edu/beaufort/library/pages/bones/bones.shtml>; and,
- Texas Information Literacy Tutorial TILT – <http://tilt.lib.utsystem.edu/>

Internet Researchers were also advised to use Google (<http://www.google.com>), Scirus (<http://www.scirus.com>) and Alltheweb (<http://www.alltheweb.com>) as search engines.

Library Researchers were given a tour of the University Library by the relevant subject librarian during which time they were briefed on how to make use of the Library to find suitable information.

The Scribes were given a short course on the use of MS Word and pointed to a number of online resources that they would find useful in completing their role in the team, namely,

- Global Community Foundation's Community Centre which offers free online courses in various applications programmes – <http://www.gcflearnfree.org/en/main/community.asp>;
- A “dummy” report to be used as a template for document layout, including citation and reference format; and,
- A number of resources dealing with scientific writing, namely:
 - Gopen, G.D. and Swan, J.A. (1990). The Science of Scientific Writing – <http://www.research.att.com/~andreas/sci.html>;
 - Richardson, A.S. (undated) Logical Fallacies in Scientific Writing. – <http://mason.gmu.edu/~arichar6/logic.htm>
 - Anon. (undated) Word Usage in Scientific Writing – <http://www.ag.iastate.edu/aginfo/checklist.html>; and,
 - Alley, M., Crowley, L., Donnell, J. and Moore C. (2001). Writing Guidelines for Engineering and Science Students – <http://www.writing.eng.vt.edu/>.

The Presenters were given a short course on the use of MS PowerPoint and pointed to a number of resources that they would find useful in completing their role in the team, namely:

- Global Community Foundation's Community Centre which offers free online courses in various applications programmes – <http://www.gcflearnfree.org/en/main/community.asp>; and,
- A number of resources dealing with public speaking, namely:
 - Public Speaking for the Weak-kneed – <http://www.tcru.ttu.edu/tcru/kc/pubs/parker/p151/p151.html>;
 - How to conquer Public Speaking Fear – <http://www.stresscure.com/jobstress/speak.html>;
 - Mortal Sins in Oral Presentations or How to Give a Talk if You Never Want to Talk Again – <http://mama.indstate.edu/dls/grad/gradsem/oral.html>; and,
 - Effective Oral Presentations – <http://icarus.csrii.iit.edu/~ahoward/itpfall97/oral.html>.

The Assessors were advised of their responsibilities as assessors and their roles in the process of completing the task. They were given access to a resource that explained assessment to them and the difference between formative and summative assessment. The assessment process was explained to this group and assessment rubrics were given to the Assessors as guides to the assessment process. The assessment process and the rubrics used will be discussed in more detail in Section 2.6.3.5: Assessment.

While group members were given specific responsibilities, it was pointed out to the students that the completion of the tasks was the responsibility of all group members and that all group members needed to be involved in every step of the process.

2.6.3.3 *The Tasks*

Six tasks were developed and assigned to the groups. In designing the tasks an attempt was made to make these tasks as authentic as possible (Herrington and Oliver, 2000), situated in the real world context that Physiologists might have to contend with in their working environment (Brown, Collins and Duguid, 1989). Note that in all instances there were two groups tackling the same task. This was done so that students could participate in the assessment process with a degree of understanding of the task they were assessing (see Section 2.6.3.5: Assessment).

The tasks were as follows:

Group 1 and 2 – A spear fisherman intends diving to 30m to hunt a barracuda. He hyperventilates before the dive to ensure that he will stay down for the longest period possible. He continues the increased ventilation rate until his blood gas pressures stabilise at a level in line with this new (increased) breathing rate. Are the new values for oxygen and carbon dioxide in the spear fisherman's blood different from normal levels? If so, explain why. Explain why the spear fisherman can remain below the water for a longer period of time after hyperventilation. Why is hyperventilation considered to be a very dangerous practice?

Group 3 and 4 – Tuberculosis is a silent disease that kills thousands of South Africans annually, even though, as often mentioned in the media, the disease can be beaten (cured). Describe tuberculosis, its causes, physiological effects, treatment of the disease and the pharmacological action of the medication used.

Group 5 and 6 – Chronic pulmonary emphysema is a disease that affects thousands of South Africans. It is commonly associated with long-term smoking. In fact, one of the characteristics of the disease is known as the "smoker's cough".

Smoking is, however, not the only cause of this disease, it can also result from long-term exposure to coal burning and dust, for example. Describe the disease, its characteristics and physiological effects on the human body.

Group 7 and 8 – We have all heard or read the advertisements telling us about the detrimental effects of smoking on our health. It affects all of us. They talk about the effects of passive smoking, inhaling somebody else's smoke, being as bad or even worse than the effects on the smoker. Recently smoking has been banned in public places. Why is it such a bad habit and what are the effects on the human body?

Group 9 and 10 – A friend of yours lands in hospital with a peculiar pulmonary condition. His pulmonary blood pressure and flow is normal, but he is breathing quite fast. His doctor indicates that his ventilation/perfusion rate is abnormal, but your friend cannot understand this. Explain the concept of ventilation/perfusion to your friend. Elaborate on the normal and extreme cases of this ratio. Include in your answer the alveolar partial pressures of gasses under these conditions.

Group 11 and 12 – You are scaling (climbing) Mount Kilimanjaro with a friend of yours. At 12 000 ft above sea level, your friend complains of a headache and nausea. You become really concerned about her health when, at about 16 000 ft, she starts experiencing convulsions and has difficulty remaining conscious. What do you suspect is wrong with your friend? Describe the physiological complications that could result from the condition. How can you help your friend?

The groups were given nine days to complete the task and participants were expected to make use of the Internet and the University Library in order to access the resources necessary to undertake the task. Each group was expected to submit a 5-page report on their task, in the format required for the course which stressed the importance of citations in the text and references at the end of the document. The document was submitted electronically in MS Word and uploaded onto the course site for access by all the participants. These initial submissions formed the formative

assessment for the course as described in Section 2.6.3.5: Assessment. The formative assessment of the tasks took place during class time on the Wednesday following the commencement of the course. On completion of the formative assessment groups had an opportunity to modify their tasks for re-submission for summative assessment. Final submissions were due for submission by midnight on the final Monday of the course. At the same time groups had to prepare a 10 minute oral presentation on their tasks, also for summative assessment, making use of MS PowerPoint. These presentations were delivered to the class on the final Wednesday of the course.

Students were warned of the dangers of plagiarism and that they ran the risk of disqualification if work was found to be plagiarised.

2.6.3.4 *Computer Mediated Communication*

WebCT's discussion tool was used for a number of purposes. A forum was established which was accessible only by members of a particular group. It was envisaged that this forum would be used by group members to asynchronously plan and execute their task responsibilities. Activities in this forum were not monitored in any way.

WebCT's discussion tool was also used to pose *ad hoc* questions to the student group as a whole. These questions were related to this particular part of the second year course in physiology. Students were expected to answer these questions and participation in this forum was mandatory and contributed to the final mark obtained by the students, allocated in the section of the assessment allocation table called "On-going assessment of attitudes to the course (i.e. participation)" (see Section 2.6.3.5: Assessment). Marks were allocated to students based on the frequency of participation by a particular student.

An Active Server Pages (ASP) web application developed by the Centre for Information Technology in Education at the University of KwaZulu-Natal and modified by the researcher for inclusion in this course was employed to manage the comments made by the groups to the submissions of the other groups. This tool

allowed for comments on a particular submission to be displayed alongside relevant areas of the submission, allowing groups to comment on the submission of the group undertaking the same task. This tool was used in conjunction with an online assessment rubric designed to assist the students to assess these submissions (see Section 2.6.3.5: Assessment).

Finally, groups were encouraged to respond to the comments on their submissions made by other groups in a WebCT forum created for that purpose, in order to stimulate discussions amongst the students and between the groups. Participation in this forum also earned students marks as part of the “On-going assessment of attitudes to the course (i.e. participation)”.

2.6.3.5 *Assessment*

A number of assessment procedures were developed in an attempt to reinforce the authentic nature of the course and to meet the adaptive, interactive and reflective nature of Laurillard's (1993) principled teaching strategy.

The first submission of tasks by the groups was done for formative assessment purposes. Groups undertaking the same task were obliged to assess each other's submissions, i.e. peer group assessment. The following assessment rubric was provided to the groups to act as a guide to the peer group assessment process:

In order to grade a submission as **EXCELLENT** it should:

1. Respond fully to what the assignment asks;
2. Contain a topic statement containing the issues to be analysed and the position of the group on that issue;
3. Show critical thinking that is clear and logical;
4. Express the argument clearly and persuasively;
5. Make use of disciplinary facts correctly;
6. Provide good supporting arguments with reasons, evidence and examples;
7. Be focussed, well organised and unified;
8. Use direct language that is appropriate to the audience;
9. Correctly documents and cites sources;
10. Be free of errors in grammar, punctuation, word choice, spelling and format;
and,
11. Display originality and creativity.

In order to grade a submission as **VERY GOOD** it should:

- Display all qualities of 1-10 above, but may lack originality and creativity.

In order to grade a submission as **ADEQUATE** it should:

- Realise adequacy in 1-10 above and demonstrate overall competence - but contain a few relatively minor errors or flaws. An ADEQUATE paper may show great creativity and originality, but these qualities do not compensate for poor or careless writing. An ADEQUATE paper is adequate in all regards but could use polish and usually looks and reads like a next-to-final draft.

In order to grade a submission as **WEAK** it should:

- Fail to realise some of the elements of 1-10 above and contain several relatively serious errors or flaws or many minor ones. A WEAK paper is less than adequate for public presentation and often looks and reads like a first or second draft.

In order to grade a submission as **POOR** it should:

- Fail to realise several elements of 1-10 above and contain many serious errors or flaws as well as many minor ones. A POOR paper usually contains fatal errors of thought or execution and usually looks and reads like private writing.

Student groups made use of an online form in order to make comments relating to specific aspects of the submission they were assessing. These comments were displayed alongside the relevant sections about which comments were being made. Groups were also obliged to complete an online form that was designed to assist group participants to assess the work of the group undertaking the same task. This form displayed elements 1-11 above and allowed students to select whether the particular element was dealt with excellently, very well, adequately, weakly or poorly by the group being assessed. Each of these categories was assigned a value from 1 to 5, with 5 representing excellent and 1 representing poor.

This form also contained an area where groups could post detailed comments about the submission that they were assessing. Groups were obliged to provide a detailed report giving reasons for their decisions as well as pointing out where improvements could be made. The results of this assessment were captured in a database and presented to the groups for consideration after the formative assessment.

The participants playing the role of subject experts in the process, the academic staff members participating, the course facilitator (researcher) and the teaching assistants also had an opportunity to comment on the submissions made by the group. In this way any misconceptions and other problem issues could be dealt with before groups made their final submissions.

While the formative assessment process was designed as formative assessment for the group being assessed, it was used as a means of summatively assessing of the group undertaking the formative assessment. This approach was employed to ensure that the groups took the formative assessment process seriously and that the process of formative evaluation was as meaningful an exercise as possible for the group being assessed. Of course, participants were advised from the outset of the approach to be taken in this regard.

On completion of the formative assessment process, groups were given an opportunity to reflect on the input from their peers and from the subject experts and reconsider their submission based on what they had learned from both the formative assessment undertaken by the other group and from the process of assessing the submission of that group.

The reflective process culminated in the resubmission of the task by the groups. This resubmission was for summative evaluation, which was undertaken by the course lecturers. When undertaking this assessment the lecturer concerned not only considered the content but also how the group had dealt with issues that had arisen as a result of comments received by the group.

The groups were also required to create an oral presentation using MS PowerPoint. This presentation was delivered to the group as a whole – including both peers and subject experts – and, again, each group participated in the assessment of the presentation of the group doing the same task, although this time assessment contributed 40% to the summative evaluation of the groups, the other 60% coming from the lecturers. A rubric was made available to the students to use as a guide in the assessment process, and group participation in this process was assessed, contributing to the group's summative assessment. The rubric used was as follows:

- Does the content relate to the title and/or purpose of the presentation?
- Is the breadth of the content sufficient?
- Is the depth of the content sufficient?
- Is the message clear?
- Is the argument consistent?
- Is sufficient evidence given to support arguments?
- Is there evidence of appropriate critical thinking?
- Are conclusions drawn appropriately?
- Is the focus sharp?
- Does the presenter put his/her own point of view?
- Is the class engaged – is their attention maintained?
- Is the response to questions and comment competent?
- Organisation and management:
 - Time keeping
 - Management of questions or comments
 - General management of whole presentation
- Presentation
 - Audibility
 - Clarity of articulation
 - Presence
 - Posture, eye contact, etc
 - Management of notes or props
 - Pace
 - Confidence
 - Use of resources (quality, fitness for purpose)
- Overhead transparencies
 - Handouts
 - Use of board or flipchart
 - Use of other resources
- Overall structure
 - Coherency, appropriateness of structure
 - Identity of beginning (summary), middle and end (conclusion)
 - Signposting of structure
- Creativity
 - Use of imagination in content or presentation
 - Originality

As with the rubric used for the formative assessment process, this rubric was presented as an online form. This rubric was also used by the lecturer to assess the group presentations.

It is important to note that all the rubrics used were made available to students at the onset of the course so that they were aware at the outset what criteria would be used and how they would be applied.

As has already been mentioned, student participation in the discussion forum in response to *ad hoc* questions set by the lecturer was also assessed. Assessment for this participation was reflected in that section of assessment called “on-going assessment of attitudes to the course (i.e. participation)”.

In order to ensure that students were rewarded for their participation within the group in order to complete the task, students were obliged to undertake a process of peer assessment. During this process, students were required to complete an online form, assessing the contribution of their peers within their group to the final product. Students could earn or lose up to 12% of the final mark awarded to the group, based on the results of this poll. This form is shown in Table 2.

Table 2: Peer Assessment Form

Aspect of Participation being Assessed	Contribution to the project				
	Below average		Average	Above Average	
Contribution to the Group Effort	-2%	-1%	0%	+1%	+2%
Formulation of Problem and Design of Study	-2%	-1%	0%	+1%	+2%
Collection of Data	-2%	-1%	0%	+1%	+2%
Analysis/Synthesis of Data	-2%	-1%	0%	+1%	+2%
Writing of Theoretical Section	-2%	-1%	0%	+1%	+2%
Presentation of Results	-2%	-1%	0%	+1%	+2%

Furthermore, students who did not participate in this process were penalised and students who did not take the process seriously, awarding the same rating to each question contained in the poll, were also penalised, and the rating discounted in the final calculation, reflected in that part of assessment called “on-going assessment of attitudes to the course (i.e. participation)”.

Students were also rewarded for participating in the Subject Evaluation exercise. This participation was reflected in that part of assessment called “on-going assessment of attitudes to the course (i.e. participation)”.

Table 3 describes the assessment groupings and the proportion that each grouping contributed to the final mark of each student.

Table 3: Assessment Groupings and Contribution to Final Course Mark

On-going assessment of attitudes to the course (i.e. participation):	10%
Contribution to discussion and assessment of tasks (formative process):	10%
Submission of written task (marked by lecturer):	40%
Oral Presentation of task (40% from student assessment and 60% from lecturer assessment):	40%
Total - Individually adjusted to account for peer review of participation within the group	100%

Finally, the total marks acquired by students in this section of the course contributed 30% to the final mark for this module. The other 70% was obtained from student performance in the second course that made up this module (30%) and the end of module examination (40%).

It is important to point out that students were made aware of this approach from the outset of the course.

Chapter 3. Methodology

This chapter deals with the methodology used in order to answer the research questions posed in Section 1.4: Research Questions. While not explicitly part of the purpose of this study, this project also represents the first tentative steps of the University of the North to monitor the process of implementation of online learning at the institution. The experience gained from this project, including the success and shortcomings of the research approach, will inform the design of a long-term implementation study to document and monitor the implementation process. As such, this project should be seen as the beginning of such an implementation study. While the main purpose of the proposed long-term implementation study will be documenting the implementation process, of equal importance will be a continual reassessment of the research approach and techniques used, based on the outcomes of previous efforts.

3.1 Design of the Study

Not only are Gage's (1989) paradigm wars being fought on the education theory front, but also on the research methodology front. As paradigms guide researchers (Vrasidas, 2001:online) it is important that researchers position themselves. Choice of research paradigm is closely linked to epistemology. The author has established his constructivist credentials and it is this point of view that will inform the research undertaken in this study.

Dahlgren (1984:23) points out that research programmes that expose student to material with little inherent meaning can only assess student ability at completing meaningless tasks. The chapter will deal with the design of this research project, bearing Dahlgren's warning in mind.

There appears to be growing disquiet within instructional technology research circles with respect to the quality of research in this field (Reeves, 2000:online). Reeves (2000:online) identified poor measurability as one of the primary concerns. As

Helberg (1995:online) put it, statistics can be used to “prove” anything if used incorrectly and even when used correctly often produce contradictory results. As mentioned earlier (see Section 1.4: Research Questions), Reeves (2000:online) suggests that one of the problems with instructional technology research is the duration of research projects and that meaningful results are only really obtainable in participatory research projects of at least five-year duration.

While Reeves’ (2000:online) approach may be desirable it is not easily implementable in a project of this nature, as a result of time constraints. However, what a project of this nature can do is lay the foundation for long-term measurement of the success of implementation strategies over a period of time. Furthermore, lessons learned from this project will inform the design and implementation of future projects. From this point of view one can consider this project as exploratory.

It is important that the research methods and data analysis approach to be used in any study are not decided on until the researcher has established clear goals for the research (Reeves, 2000:online). This places an enormous burden on the researcher when designing mechanisms for data collection, data interpretation and the use of statistics as an analysis tool (Foddy, 1993).

The goals of this project, namely answering the research questions posed in Section 1.4: Research Questions, have been identified. The project employed both quantitative and qualitative methodologies in order to try and address these questions. With careful consideration of epistemological implications, these qualitative and quantitative methodologies, if used correctly, have a role to play – one informing the other. Examples of this include Hart (1997:online), Jones (1997:online) and Kelle (2001:online). Hart (1997:online) points out that researchers should consider all research methodologies as tools in a research toolbox and make use of the most appropriate tools for a particular job. This approach of mixing methodologies is known as triangulation, the assumption being that the “combination of methodologies . . . can focus on their relevant strengths” (Jones, 1997:online). However, Kelle (2001:online) warns of the danger of one methodology misinforming another and researchers need to be aware of the obstacles inherent in this approach.

3.1.1 Quantitative Research Analysis Techniques

The greatest strength of statistics and the quantitative methodology in the social sciences lies in being able to infer patterns in populations from an analysis of the views of a sample of that population (Myers, 1997:online). According to Jones (1997:online) quantitative methodologies measure overt behaviour, they allow for comparison and replication and the reliability and validity of the outcomes can be objectively determined.

In short, the role of quantitative research methodologies is to turn theoretical concepts into observable measurements. Quantitative data analysis can do no more than measure the “observable” within a population. Quantitative data analysis is not good at establishing the unknown or the underlying reasons for the observable, which is further weakened by the size of the population and its reaction to being observed.

In this project quantitative techniques will be used to analyse both student perceptions and student performance. Student perceptions will be analysed from the data collected from the first 27 questions of the Subject Evaluation Questionnaire (see Section 3.2: Data Collection). Student performance will be analysed using the results which the students obtained for the module PLGY232 and compared to results obtained in the following module PLGY242 for both 2001 and 2002.

3.1.2 Qualitative Research Analysis Techniques

According to Fetterman (1988:17), qualitative researchers are more likely to employ descriptive techniques and to situate themselves in the research. Salomon (1993) describes the qualitative process as being based on the assumption that:

... each event, component, or action in the [social process] has the potential of affecting the [social process] as a whole. ✓

Salomon (1993) goes on to say that an understanding of these social processes is achieved as a result of the richness of detail gathered in a variety of ways. This is, in fact, the essence of a qualitative approach to understanding the processes of life – gathering a richness of detail while situated within the research itself where a clear ✓

distinction is made between data gathering and data analysis (Myers, 1997:online). One of the great strengths of qualitative research is the situated involvement of the researcher in the research and, thus, the outcome of qualitative research rests heavily on the skills, personal integrity and professional conduct of the researcher (Qualitative Research Consultants Association, undated).

According to Seidel (1998:online) the process of qualitative data analysis is an iterative and progressive, recursive and holographic process of noticing, collecting and thinking. While Hart (1997:online) believes that the conclusion must be coaxed, never forced, from the data – and how this is done will be the ultimate test of the conclusions reached in the study. In other words, the process of reaching the conclusion is as important as the conclusion itself. The process, according to Hart (1997:online), evolves around the gradual development of ideas about data and the exploration of these ideas.

Chenail (2000:online) points out that it is important for a researcher working within a qualitative paradigm to establish what he calls a “research posture”, i.e. the relationship the researcher would like to have with those involved in the research project. Researchers need to understand where they themselves are coming from in the research process and, by implication, how this influences the research methodology and outcome of a particular project.

Qualitative techniques were used to analyse the two open-ended statements made by respondents to the Subject Evaluation Questionnaire (see Section 3.2 Data Collection) in order to get a better understanding of the results obtained in the quantitative analysis of the data obtained from the Subject Evaluation Questionnaire.

3.2 Data Collection

The study analysed the three sources of data identified in the previous section.

3.2.1 Subject Evaluation Questionnaire

On completion of the course, students were requested to complete a Subject Evaluation Questionnaire. Feedback obtained from students is an important tool used in the evaluation of courses implemented in education, particularly higher education. In Australia the Course Evaluation Questionnaire, developed by Paul Ramsden, is a survey implemented annually across all higher education institutions in that country as a quality assurance exercise (Waugh, 1998:online).

The survey tool used in this study is a modification of the Course Evaluation Questionnaire which developed by the University of Technology, Sydney, Australia. A seven point rating scale was used. For questions 1-25 the rating scale categories were Very Strongly Agree, Strongly Agree, Agree, Uncertain, Disagree, Strongly Disagree and Very Strongly Disagree. For questions 26 and 27 the rating scale categories were Very Highly, Highly, Average, Uncertain, Not so Good, Poorly and Very Poorly. A value of 1 to 7 was assigned to each of the categories, with 7 representing greatest satisfaction and 1 representing least satisfaction. Two open-ended questions also formed part of the questionnaire, which allowed participants to express themselves with a greater degree of freedom. These were points 28 and 29. The Subject Evaluation Questionnaire is presented in Table 4.

Table 4: Subject Evaluation Questionnaire

1. It was easy to know the standard of work expected from this course:
2. The subject developed my problem-solving skills:
3. The teaching staff motivated me to do my best work:
4. The workload was too heavy:
5. The subject sharpened my analytical skills:
6. I usually had a clear idea of where I was doing and what was expected of me in this subject:
7. The staff put a lot of effort into commenting on my work:
8. To do well in this subject all you really need is good memory:
9. The subject helped me to develop my ability to work as a team member:
10. As a result of participating in this course I feel confident about tackling unfamiliar problems:
11. The subject improved my skills in written communication:

12. Staff seemed more interested in testing what I had memorised than what I had understood:
13. It was often hard to discover what was expected of me in this subject:
14. I was generally given enough time to understand the things I had to learn:
15. The staff made a real effort to understand the difficulties I might have had with my work:
16. The assessment methods employed in this subject required an in-depth understanding of the subject content:
17. Teaching staff normally gave me helpful feedback on how I was doing:
18. Teaching staff were extremely good at explaining things:
19. Too many of the questions asked were just about facts:
20. Teaching staff worked hard to make this subject interesting:
21. There was a lot of pressure on me as a student in this subject:
22. The subject helped me to develop my ability to plan my own work:
23. The sheer volume of work to go through in this subject meant that it could not all be thoroughly comprehended:
24. The staff made it clear right from the start what was expected of students:
25. Overall I am happy with the quality of this subject:
26. All things considered I would rate this subject:
27. All things considered I would rate the teaching of this subject:
28. Additional Comments about the Subject:
29. Additional Comments about the Approach:

The major difference between the Subject Evaluation Questionnaire designed by the University of Technology, Sydney, Australia and the Course Evaluation Questionnaire developed by Ramsden (1992:271) is the emphasis on generic skills found in the questions posed by the University of Technology questionnaire as opposed to the emphasis on independence found in the questions posed by Ramsden's Course Evaluation Questionnaire (Ramsden, 1992:104). This difference is important in the context of this study in light of its emphasis on the generic skills required by the South African Qualifications Authority. It was this factor that influenced the choice of evaluation tool.

Like the Course Evaluation Questionnaire on which this survey tool was based (Ramsden, 1992:104), the subject Evaluation Questionnaire developed by the University of Technology, Sydney, Australia assigns the questions above into six categories as follows:

Good Teaching

3. The teaching staff motivated me to do my best work
7. The staff put a lot of effort into commenting on my work
15. The staff made a real effort to understand the difficulties I might have had with my work
17. Teaching staff normally gave me helpful feedback on how I was doing
18. Teaching staff were extremely good at explaining things

20. Teaching staff worked hard to make this subject interesting

Clear Goals and Standards

- 1. It was easy to know the standard of work expected from this course
- 6. I usually had a clear idea of where I was doing and what was expected of me in this subject
- 13. It was often hard to discover what was expected of me in this subject
- 24. The staff made it clear right from the start what was expected of students

Appropriate Workload

- 4. The workload was too heavy
- 14. I was generally given enough time to understand the things I had to learn
- 21. There was a lot of pressure on me as a student in this subject
- 23. The sheer volume of work to be got through in this subject meant that it couldn't all be thoroughly comprehended

Appropriate Assessment

- 8. To do well in this subject all you really needed was a good memory
- 12. Staff seemed more interested in testing what I had memorised than what I had understood
- 16. The assessment methods employed in this subject required an in-depth understanding of the subject content
- 19. Too many questions asked were just about facts

Generic Skills

- 2. The subject developed my problem solving skills
- 5. The subject sharpened my analytic skills
- 9. The subject helped me to develop my ability to work as a team member
- 10. As a result of participating in this course I feel confident about tackling unfamiliar problems
- 11. The subject improved my skills in written communication
- 22. The subject helped me to develop my ability to plan my own work

Overall rating:

- 25. Overall I am happy with the quality of this subject:
- 26. All things considered, how would you rate this subject?
- 27. All things considered, how would you rate the teaching in this subject?

The results obtained from this questionnaire were analysed in two ways. Firstly, the results for each of the statements 1 to 27 were analysed quantitatively by adding together the results for each question and dividing the sum by the number of responses received for that particular question from the participants in order to obtain a mean rating for each of the questions. These results were then dealt with according to the six categories listed above. The means of responses to each question making up a category were added together and divided by the number of

questions making up the category (see Table 6 in Chapter 4). The mean thus obtained was then deemed to represent the student satisfaction rating for that category. This statistical analysis was undertaken using SPSS version 9.

The open-ended statements were designed to elicit from the participants in the course responses in their own words describing how they felt about the approach to the teaching and how they felt about the use of technology (at least that was the intention, see Section 5.2.2: Qualitative Analysis of Student Perceptions, for commentary on the design of open-ended statements). The open-ended statements were analysed quantitatively. This process involved screening the responses of the participants for themes that shed light on the student perceptions of the course. During this process the researcher developed a coding structure that allowed for responses to be categorised into a number of themes pertinent to the study. The responses to each of the submissions by the respondents were then analysed in terms of these theme categories. The frequencies of responses per category were calculated in order to get some idea of how the participants felt about the approach to the subject and the approach to the course. The qualitative data analysis was undertaken using NVivo version 9.

3.2.2 Student Performance Data

It was also important for the researcher to determine the effect of course implementation on the performance of the students participating in the course. In order to do this a statistical analysis was undertaken to compare the performance of students in 2002, the year during which the redesigned course was implemented, with the performance of students in 2001. Before describing how this analysis was undertaken it is important to point out that the results of the student performance for this specific three week course in 2001 were no longer available. As a result it was not possible to use this student performance data for the course itself in order to make a direct comparison between student performance in 2001 and 2002.

However, this three week course accounted for 30% of the module mark in PLGY232 in both 2001 and 2002 and it was decided that this module mark from both 2001 and 2002 would at least give an indication of the effect of the course on student performance. The effect of the course on student performance was ascertained by

employing a paired-samples *t*-test in order to compare the means of the results of students undertaking the PLGY232 course with the results obtained by the same students doing the following module, namely PLGY242, in each of the years. These results were examined in order to determine whether the implementation of the computer-mediated course had any effect on student performance. As mentioned in the beginning of this document, in Section 1.4: Research Questions, it was recognised that this approach would not stand up to rigorous of statistical analysis, however, it was felt that this approach would at least gave an indication of the effect of the course on student performance.

3.2.3 Reflective Journal

The researcher kept a journal throughout the planning and implementation phase of the project. Highlights from this journal will be discussed in Chapter 5: Discussion, with particular reference to research questions 1 to 4.

3.3 Position of Researcher

Finally in a study of this nature it is important that the researcher is clear. The researcher was a participant observer, with an axe to grind. As the literature review undertaken in Chapter 2: Theoretical Framework pointed out, a number of authors in the field of tertiary education, believe that tertiary education is in need of fundamental change with respect to dominant pedagogy and approach, a position that this researcher subscribes to. As the Cognition and Technology Group at Vanderbilt, Learning Technology Center (1993:76) point out:

We claim we want to help students learn to think deeply about subject matter, but we give them texts filled with vast amounts of superficial facts to be memorized, leaving students no time to explore a few topics in depth.

We claim that we want students to learn with understanding, yet we often overload our instruction with (a) decontextualized basic-skill and concept exercises that have to be mastered before students get to see potential applications of these basics; and (b) technical definitions and formulas presented in ways that fail to help students link the technical knowledge with their intuitions.

We claim that we want our students to learn to find, define and solve problems, but give them nothing but arbitrary problems that are uninteresting, unrealistic, and leave no room for problem posing on the part of students.

We claim that we want to help students develop a sense of pride, responsibility, and curiosity. Yet, we spend from 12 to 16 years treating them as passive recipients of knowledge who are rarely given the opportunity to explore ideas of their own choosing, collaborate with others and make contributions by presenting ideas to their classmates and teachers.

The author's experiences with both instructivist and constructivist approaches to learning have led the author to conclude that there is a great deal of merit in the constructivist approach. A comment received from a student who undertook this course:

Subject: Fun studies

hi guys! can you see how fun is physiology this time. unlike what we do on other courses, in physiology we have time to discuse through the internet, we have oppotunity to work on ourselves so that we can understand our work. not only craming and passing and forget. Guys lets make use of this oppoturnity. GOOD LUCK!!!

Posted by [name withheld] on Wed Jul 24, 2002 18:12

and a comment received from a lecturer on his first experiences in an online environment:

Hi Andy I thought I'd related the following to you:

I teach a course in Health Education, specifically chronic diseases of lifestyle, to 1st and 2nd year Education students. At this early stage, they are required to master a lot of content, which is usually done through quite a bit of lecturing and tasks. The former especially the students find boring [surprise!]. So I decided to do something totally different!

Essentially what I wanted the students to do was to get to grips with a table which related mode, frequency, intensity and duration of physical activity to various age groups from children to the aged. So I booked a GP computer lab for 2 sessions a week for about 6 weeks, and told the students I was not going to give them the information, and that they would have to find it. Not only that, but at the end of the module each group [4-6 people] would have to present what they found using MS PowerPoint. I gave them the WHO website and some other online resources for PowerPoint and the do's and dont's of public speaking, and sent them on their way. Needless to say they were shocked [and I was wondering whether I had opened Pandora's box]!

After the initial shock, the students realised that this was a lot more fun than falling asleep during lectures and got on with the task. Many had never used PowerPoint before, and many had to learn how to email themselves the work they had done during each session [I booked GP2 instead of GP1]. I was present not to lecture but to serve as a guide and soundboard. The students emailed me the presentations, I gave some feedback, which seemed to work quite well.

Was I surprised at what the groups produced at the end of the module!!! The students admitted that they had spent many a late night trying to put the presentation together, and it was rather special to see the sense of accomplishment these kids felt at having used PowerPoint for the first time. Not only that but they urged me to continue with this mode so that they can become more proficient in using PowerPoint and doing presentations.

So what started as a bland table of facts turned into a rich learning experience which touched a number of important skills. Most importantly, the students want to learn! All it took was a little bit of technology, nothing fancy!

So to my fellow Bathlami classmates, if you're wondering whether you should take the plunge... DO!!

Regards [name withheld]

serve to reinforce the author's conviction that a constructivist-informed, computer-mediated approach to learning in higher education holds much promise as a means of improving the learning experiences of students in a tertiary education environment.

Having dealt with the methodology used to analyse the data obtained in this study and having dealt with the position of the researcher with respect to this project it is now necessary to deal with the results of the analysis of this date, which will be undertaken in the next chapter, Chapter 4: Results.

Chapter 4. Results

The aim of the project was to answer five research questions, namely:

1. How did the implementation of a constructivist-informed, computer-mediated course in a second (final) year course in the discipline of Physiology at the University of the North, with particular emphasis on the development of an authentic learning environment in the cognitive apprenticeship tradition enhance the worth of the course in the eyes of the learners participating in the course?
2. How did the students participating in the course experience the computer mediation?
3. How did the students participating in this course experience the approach?
4. What issues arising from the implementation of this course would need to be addressed in order to improve the chances of success in future courses of similar design and approach?
5. What effect did the implementation of this course have on the academic achievements of those participants?

Question 4 did not require data analysis and will be dealt with in Chapter 5:

Discussion (see Section 5.5: Research Question 4). This chapter will deal with the analysis of the data collected with respect to the remaining 4 research questions.

In the interests of clarity the attention of the reader is drawn to the fact that the results were obtained from an analysis of data obtained from two sources. In the first instance, data was obtained from a Subject Evaluation Questionnaire that participants completed at the end of the course – dealt with in Section 4.1: Student Perceptions of the Course. In the second instance the results of student performance in the study year (2002) were analysed against results obtained by students in a control year (2001). Student performance results obtained for two courses, namely PLGY232 and PLGY242, in each year, namely 2001 the control year and 2002 the year of the study, were used for this analysis – dealt with in Section 4.2: The Effect of the Course On Student Achievement.

4.1 Student Perceptions of the Course

Both qualitative and quantitative methodology was employed in order to establish whether the implementation of computer mediation in support of a principled teaching strategy in a second (final) year course in the discipline of Physiology (PLGY232, 2002), with emphasis on authentic learning environments and computer mediated communication, enhanced the worth of the course in the eyes of the participants.

The results analysed in this section were obtained from the Subject Evaluation Questionnaire. Participation in the questionnaire was optional – however, students were urged to participate, and take such participation seriously, on the grounds that participation would be of benefit to future students as the lecturers would be able to improve on their course offerings in the future. Students also gained a bonus mark allocated in the assessment category “On-going assessment of attitudes to the course (i.e. participation)” for participation.

The students completed the Subject Evaluation Questionnaire online and the results were immediately captured in a Microsoft Access database. The results were then imported into a Microsoft Excel file and computed in SPSS.

4.1.1 Analysis of Categorical Data Collected from the Subject Evaluation Questionnaire

As pointed out in Chapter 3, the Subject Evaluation Questionnaire was designed so that student perceptions in six categories could be determined. The six categories and the questions in the Subject Evaluation Questionnaire that relate to these categories are listed in Table 5. Note that this table does not include the open-ended questions, which will be dealt with in a later section of this chapter.

Table 5: Subject Evaluation Questionnaire Categories and Questions Related to that Category

Category	Subject Evaluation Questionnaire Questions (numbers refer to the order in which the questions were posed in the questionnaire)
Good Teaching	3. The teaching staff motivated me to do my best work 7. The staff put a lot of effort into commenting on my work 15. The staff made a real effort to understand the difficulties I might have had with my work 17. Teaching staff normally gave me helpful feedback on how I was doing 18. Teaching staff were extremely good at explaining things 20. Teaching staff worked hard to make this subject interesting
Clear Goals and Standards	1. It was easy to know the standard of work expected from this course 6. I usually had a clear idea of where I was doing and what was expected of me in this subject 13. It was often hard to discover what was expected of me in this subject 24. The staff made it clear right from the start what was expected of students
Workload	4. The workload was too heavy 14. I was generally given enough time to understand the things I had to learn 21. There was a lot of pressure on me as a student in this subject 23. The sheer volume of work to be got through in this subject meant that it couldn't all be thoroughly comprehended
Assessment	8. To do well in this subject all you really needed was a good memory 12. Staff seemed more interested in testing what I had memorised than what I had understood 16. The assessment methods employed in this subject required an in-depth understanding of the subject content 19. Too many questions asked were just about facts
Generic Skills	2. The subject developed my problem solving skills 5. The subject sharpened my analytic skills 9. The subject helped me to develop my ability to work as a team member 10. As a result of participating in this course I feel confident about tackling unfamiliar problems 11. The subject improved my skills in written communication 22. The subject helped me to develop my ability to plan my own work
Overall Rating	25. Overall I am happy with the quality of this subject 26. All things considered, how would you rate this subject 27. All things considered, how would you rate the teaching in this subject

Responses to the questions in the Student Evaluation Questionnaire were assigned values as follows:

1 – Very Strongly Disagree, 2 – Strongly Disagree, 3 – Disagree, 4 – Uncertain, 5 – Agree, 6 – Strongly Agree and 7 – Very Strongly Agree for all questions except questions 26 and 27, where the responses were graded as:
7 – Very Highly, 6 – Highly, 5 – Average, 4 – Uncertain, 3 – Not so highly, 2 – Poorly and 1 – Very Poorly.

Questions 4, 8, 12, 13, 19 and 23 were negatively posed and the responses to these questions were transposed so that all questions were analysed as positive responses.

Student responses to questions in each category were added together and the mean of these responses established in order to obtain an overall picture of student perceptions in each category. This overall picture was obtained by applying descriptive statistics (minimum, maximum, mean and standard deviation), which provide summary statistics for continuous numeric variables, to the averages in each student perception category (see Table 6).

Table 6: Questionnaire Category Descriptive Statistics (n=45)

Questionnaire Category	Minimum	Maximum	Mean	Std. Deviation
Good Teaching	3.5	6.7	5.5	0.7
Goals and Standards	3.3	6.5	5.0	0.7
Workload	2.5	5.5	4.1	0.8
Assessment	2.3	5.0	3.8	0.7
Generic Skills	3.8	7.0	5.7	0.7
Course Overall	4.0	7.0	5.8	0.8

In summary, the categories Good Teaching (\bar{x} 5.5±0.7), Goals and Standards (\bar{x} 5.0±0.7), Generic Skills (\bar{x} 5.7±0.7) and Overall Rating of the course (\bar{x} 5.8±0.8) all appear to be positively perceived by the student respondents, while the categories Workload (\bar{x} 4.1±0.8) and Assessment (\bar{x} 3.8±0.7) appear to have been negatively perceived by the student respondents.

4.1.2 Correlation between Student Perceptions and Student Achievement

In section 2.4.2: Computer-mediated Learning Environments, reference was made to a correlation between student perceptions and student achievement (Hong 2002). As the data was available, it was decided to test whether there was a statistical correlation between student perceptions of the course and student achievement, if the data allowed for this calculation to be made. In order to test the state of the data, a scatter plot was created for each of the questionnaire categories against the marks obtained by the students participating in the course who had completed the questionnaire. Unfortunately one of the requirements for the calculation of meaningful correlations, namely evidence of a linear relationship between the datasets, could not be met and thus it was impossible to establish any correlation between performance and perceptions. The r^2 linear values for each of the questionnaire categories plotted against student performance are given in Table 7.

Table 7: Correlations of Questionnaire Categories with Student Achievement

Questionnaire Category	r^2 linear values
Good Teaching	0.051
Goals and Standards	0.074
Workload	0.039
Assessment	0.024
Generic Skills	0.001
Course Overall	0.006

4.1.3 Qualitative Data Analysis of Student Perceptions

The Subject Evaluation Questionnaire also contained two sections where students could make open-ended submissions. These open-ended submissions were:

1. Additional comments about the subject;
2. Additional comments about the approach.

The responses of the 45 respondents who voluntarily responded to the questionnaire were imported into NVivo and analysed qualitatively.

After reflecting on the comments the researcher identified 12 characteristics of the student responses to submission 1 and 10 characteristics of student responses to submission 2 as important and worth highlighting. The categories, codes, and definitions used to describe the categories are given in Table 8 and Table 9.

Table 8: Codes, Categories and Definitions – Submission 1

Code	Category	Definition
Pos	Positive	Student responses to open-ended submissions where feedback was considered of a positive nature
Pres	Positive with reservations	Student responses to open-ended submissions where feedback was considered of a positive nature, however, certain reservations were expressed
Psug	Positive with suggestions	Student responses to open-ended submissions where feedback was considered of a positive nature, and suggestions were made relating to the improvement of either the subject or of the course
Pskil	Positive with reference to skills	Student responses to open-ended submissions where feedback was considered of a positive nature, and reference was made to the acquisition of skills
Popp	Positive with reference to opportunities presented	Student responses to open-ended submissions where feedback was considered of a positive nature, and reference was made to the opportunities that opened up to the respondent
Neg	Negative	Student responses to open-ended submissions where feedback was considered of a negative nature
Nass	Negative comments concerning assessment	Student responses to open-ended submissions where feedback was considered of a negative nature, specifically highlighting assessment as problematic
Nteach	Negative comments concerning teaching	Student responses to open-ended submissions where feedback was considered of a negative nature, specifically highlighting teaching as problematic
Nwork	Negative comments concerning workload	Student responses to open-ended submissions where feedback was considered of a negative nature, specifically highlighting workload or time management as problematic
Nsupp	Negative comments concerning support	Student responses to open-ended submissions where feedback was considered of a negative nature, specifically highlighting support received as problematic
Neu	Neutral	Student responses to open-ended submissions where feedback was considered neither positive nor negative, most of these comments were in the form of suggestions
NC	No Comment	Responses that were left blank, or where students used the words “no comment” or similar

Table 9: Codes, Categories and Definitions – Submission 2

Code	Category	Definition
Pos	Positive	Student responses to open-ended submissions where feedback was considered of a positive nature
Pres	Positive with reservations	Student responses to open-ended submissions where feedback was considered of a positive nature, however, certain reservations were expressed
Psug	Positive with suggestions	Student responses to open-ended submissions where feedback was considered of a positive nature, and suggestions were made relating to the improvement of either the subject or of the course
Pskil	Positive with reference to skills	Student responses to open-ended submissions where feedback was considered of a positive nature, and reference was made to the acquisition of skills
Pasp	Positive with reference aspects of the course	Student responses to open-ended submissions where feedback was considered of a positive nature, and reference was made to aspects of the course that they specifically found positive
Neg	Negative	Student responses to open-ended submissions where feedback was considered of a negative nature
Napp	Negative comments concerning overall approach	Student responses to open-ended submissions where feedback was considered of a negative nature, specifically highlighting overall approach as problematic
Nteach	Negative comments concerning teaching	Student responses to open-ended submissions where feedback was considered of a negative nature, specifically highlighting teaching as problematic
Neu	Neutral	Student responses to open-ended submissions where feedback was considered neither positive nor negative, most of these comments were in the form of suggestions
NC	No Comment	Responses that were left blank, or where students used the words “no comment” or similar

It must be emphasised here that English is not the first language of the students who participated in the course; in fact it is often their third or fourth language. This is reflected in the language of the comments and it was often up to the researcher's local knowledge to interpret the meaning of some of the comments. For example if someone is “quite pleased” one can interpret that as being “extremely satisfied”. Also in this regard, where student comments are quoted in this section, no attempt was made to correct either spelling or grammar.

The following three sections deal with the results of the qualitative analysis of the student responses to the two open-ended submissions in the Subject Evaluation Questionnaire.

4.1.3.1 Analysis of Comments about the Subject – Submission 1

Of the 45 responses received concerning Submission 1, additional comments specifically about the subject, 34 responses were positive, 3 were positive with reservations, 5 were negative and 3 did not comment. In other words 82.2% of the class were positive about the subject as a whole, although 6.7% did have reservations; 11.1% were negative and 6.7% did not comment (see Figure 1).

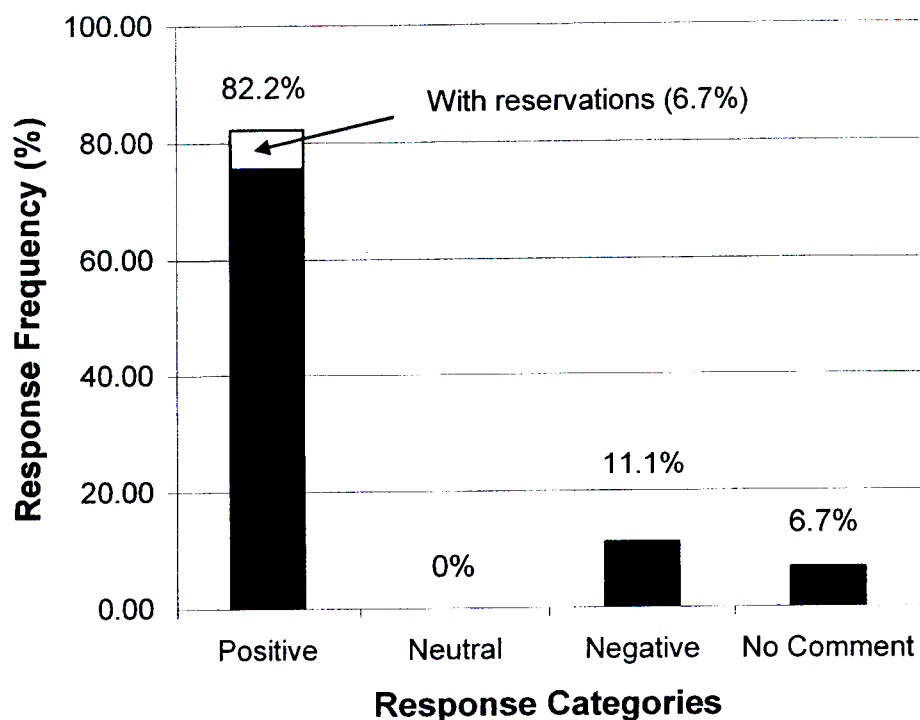


Figure 1: Breakdown of student responses per category identified by the researcher (n=45)

Positive Comments

Eight of the students who commented positively – representing 17.8% (n=45) of all student respondents and 21.6% (n=37) of students who responded positively – did not elaborate further and their comments ranged from “good” and “very good” to “It was interesting and we had courage to attend it” and “Can’t comment any further, I was quite pleased”.

The remaining positive comments were further interpreted and categorised as follows:

- a) Positive comments with suggestions;
- b) Positive comments indicating skills acquired; and
- c) Positive comments that indicated the promotion of opportunities for the respondent.

a) Suggestions

The responses of 4 respondents – representing 8.9% (n=45) of all the respondents and 10.8% (n=37) of the students who responded positively – included suggestions, all concerning continuing the approach, extending the approach of the subject to other parts of the physiology course or extending the approach to other courses in their curriculum. Comments reflecting student sentiments included “I think it will be very advisable for the staff to continue doing things this way”; “This method should be used in every module” and “I wish some of the lecturers can use the system that we have been using in this subject”.

b) Skills

The responses of 8 respondents – representing 22.2% (n=45) of all the respondents and 27.0% (n=37) of students who responded positively – included the acquisition of skills as an outcome of participation in the subject. Of these, 2 students alluded to the enhancement of their communication skills; for example, “This course helped us not to be shy to express our feelings to our mates”. A further 2 students alluded to enhancement of their critical thinking skills; for example, “It developed our critical thinking”. Two students saw the research approach to the subject as important to them, for example by way of illustration “It deals with postgraduate method of study”. One student alluded to the enhancement of group work skills – “Also learned to work as a group”. Finally, one student alluded to the importance of being able to work under pressure – “The more we work under pressure, is the more we learn”.

c) Promotion of Opportunities

The responses of 17 students – representing 37.8% (n=45) of all respondents and 46.0% (n=37) of all students who responded positively – included the promotion of opportunities as an outcome of their participation in the subject. Two categories

stand out here with seven responses each, namely the promotion of a learning opportunity and the promotion of access to technology.

In the learning opportunity category responses ranged from "...extending my knowledge..." and "I have learned a lot as an individual" to "...it needs understanding not memorising" and "These subject needs understanding not memorising. A student need to know and understand the facts and importance of the subject".

In the promotion of access to technology category responses ranged from "We had the opportunity to learn how to use computer" and "Free access to computer" to "this course taught me and a lot of my friends so much on computers. I always took computers for granted, but not until I started with this course. There are a lot of things that I learned about computers, apart from this course- like using e-mail's and brow[ser]".

A further three students felt that the subject promoted anytime access to the course material, for example, "because you can in your own time follow the work done in class".

Positive Comments with Reservations

The comments made by the 3 students who commented positively with reservations – representing 6.7% (n=45) of all respondents and 8.1% (n=37) of all students who responded positively – were divided in terms of these reservations (see Figure 2).

The use of technology and technology support was a cause for concern, with two students remarking on this aspect of the subject – "...spending much time on the computer..." and "i wish more time will be provided on learning how to use the computer because other things like formating of the presentation even now it is not clearly captured". Two responses also indicated reservations with the method of assessment – "We should have been given quiz as away of testing our understanding" and "The problems are: the methodology used for assessments was "BAD"(not settling)". Finally, one of the student respondents also had a problem with the fact that practical classes were done away with in order to accommodate the online course in the curriculum – "&the way practicals were conducted.About practicals,it was totally not good to perform a pract without".

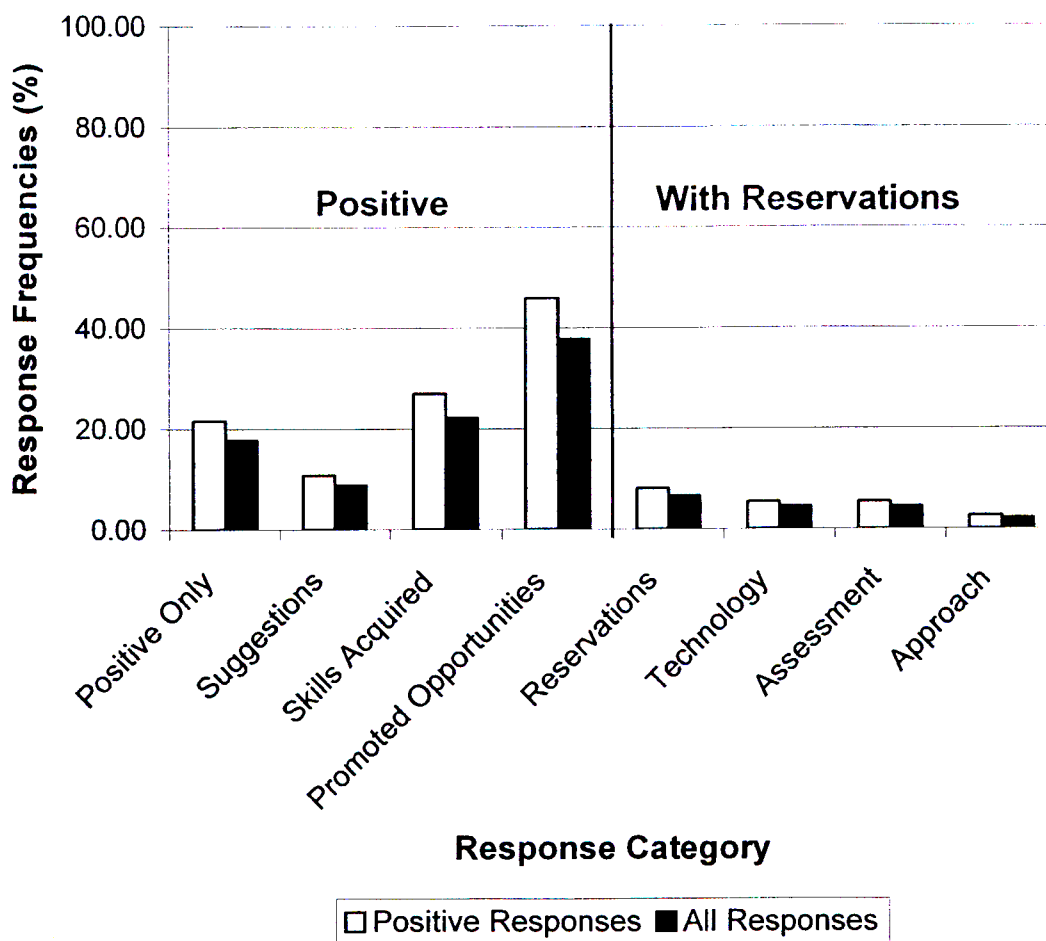


Figure 2: Frequency of positive responses (including positive responses with reservations) into categories as a percentage of all the positive comments (n=37) and as a percentage of total student responses (n=45)

Negative Comments

Of the 5 students who responded negatively to the subject 2 students – representing 4.5% (n=45) of all respondents and 40.0% (n=5) of all students who responded negatively – were concerned about the method of assessment, and commented “The problem is to accessing by other student, b'cos student have more problem among they are self will give insufficient marks rather than any lecture of physiology will give the marks you have” and “I suggest that you gave each individual a task to do so that you evaluate their ability and capabilities based on the subject. Because some of us would like to persuade it as one of our majors”. One student – representing 2.2%

(n=45) of all respondents and 20.0% (n=5) of all students who responded negatively – had a problem with the teaching approach of this subject – “The lecture should improve his teaching method in order to improve the overall percentage mark of this course”. One student – representing 2.2% (n=45) of all respondents and 20.0% (n=5) of all students who responded negatively – had a problem with the time/workload aspect of the subject – “Time given to the modules is very little and makes it hard to grab up everything bearing in mind that we have other courses at hand!the load is too much!”. One student – representing 2.2% (n=45) of all respondents and 20.0% (n=5) of all students who responded negatively – had a problem with the level of support offered – “More effort need to be put on helping students with difficulties on this course” (see Figure 3).

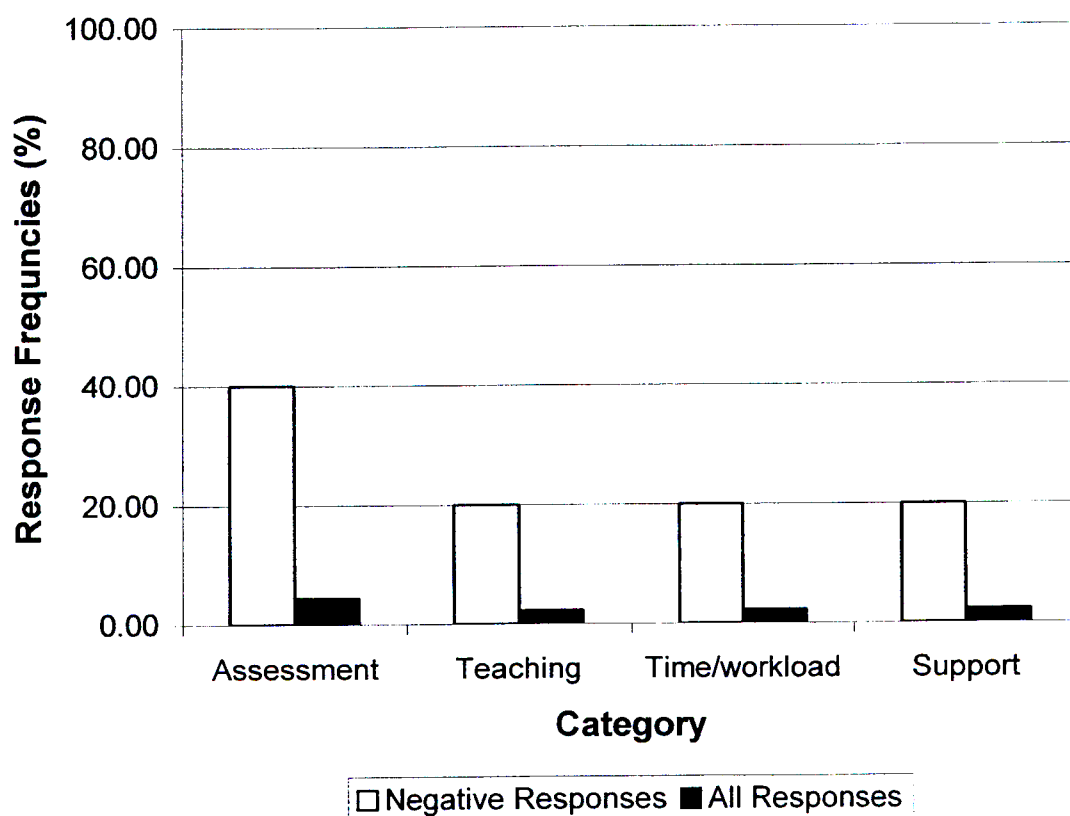


Figure 3: Frequency of negative responses into categories as a percentage of the all positive comments (n=5) and as a percentage of total student responses (n=45)

4.1.3.2 Analysis of Comments about the Subject – Submission 2

Of the 45 responses received concerning Submission 2, additional comments specifically about the course approach, 28 responses were positive, 7 responses were positive with reservations, 2 responses were deemed neutral by the researcher, 4 responses were negative and 4 did not comment. In other words 77.8% of the class were positive about the approach as a whole, although 13.2% did have reservations, 4.5% of the class were neutral about the approach, 8.9% were negative and 8.9% did not comment (see Figure 4).

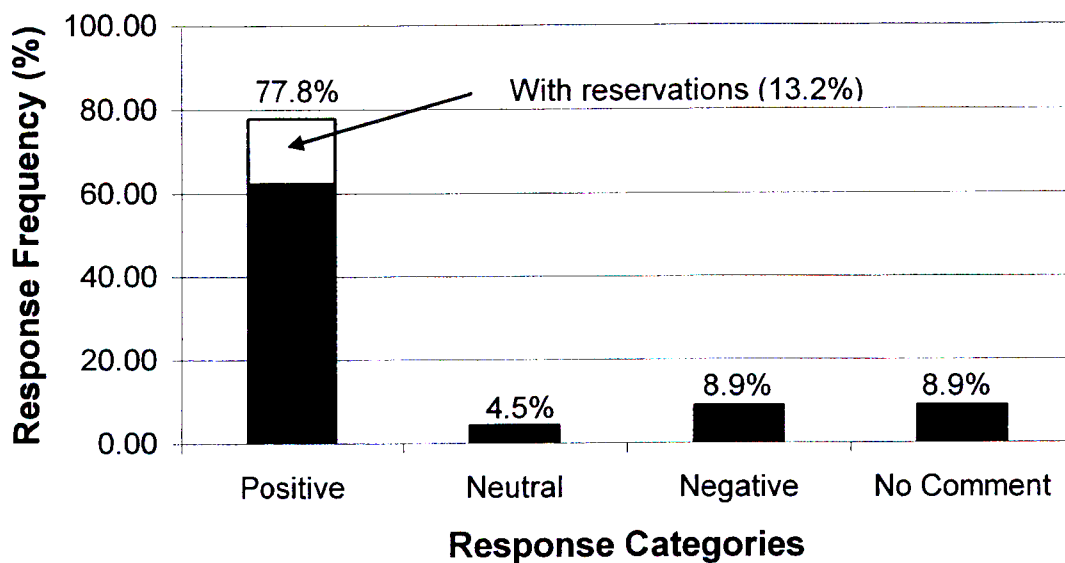


Figure 4: Breakdown of student responses per category identified by the researcher (n=45)

Positive Comments

Fifteen of the students who commented positively – representing 33.3% (n=45) of all student respondents and 42.9% (n=35) of students who responded positively – did not elaborate further and their comments ranged from “good” and “very good” to “Also the approach was very impressive” and “Very nicely, don’t crush anyone, excellent”.

The remaining positive comments were further interpreted and categorised as follows:

- a) Positive comments indicating skills acquired;
- b) Positive comments that indicated the promotion of opportunities for the respondent; and
- c) Positive comments indicating which aspect of the course the respondent found positive.

a) Skills

The responses of 2 respondents – representing 4.5% (n=45) of all the respondents and 5.7% (n=35) of students who responded positively – included the acquisition of skills as an outcome of the course approach. Of these, 1 student felt that the ability to link course material with other subject matter was an important outcome of the course approach – “It encourage us to link what we have learned previously with the present work”. The other skills-related response indicated that the student perceived the importance of accessing resources as an important skill acquired as a result of participating in the course – “Becuase we learned to consuld with our books most of the time”.

b) Promotion of Opportunities

The responses of 6 students – representing 13.3% (n=45) of all respondents and 17.1% (n=35) of all students who responded positively – included the promotion of opportunities as an outcome of the course approach. Of these, 3 students indicated access to technology as an important opportunity, for example “It has opened my eyes in the world of computers(internet)!!”. A further 2 students indicated that the approach promoted knowledge acquisition or learning, for example “After this we will feel that we were learning”. While 1 student indicated that the opportunity to access the course material at any time was an important opportunity as a result of participation in the course – “If missed class you had a chance to go to the computer and check lecture notes”.

c) Positive Aspects

The responses of 7 students – representing 15.6% (n=45) of all respondents and 20.0% (n=35) of all students who responded positively – expanded on aspects of the course that were positive for them. Of these respondents 4 were positive about the approach overall, for example “Nothing like this has ever being done in this

course, so the approach was actually good and the deliverance was understandable” and “An interesting approach. it was unpredictable and produced fruitful results and I salute the staff for this marvelous idea”. A further 3 responses indicated that students were positive about the support they received, for example “The staff was dedicated in helping us in learning more about this course”.

Positive Comments with Reservations

The comments made by the 7 students who commented positively with reservations – representing 15.6% of all respondents and 20.0% (n=35) of all students who responded positively – were divided in terms of their reservations about the approach. Two comments indicated that students had difficulty adjusting to the course approach, at least at first, for example “Firstly it was hard for me but I realise that nothing is impossible”. A further 2 students had reservations about the use of technology, for example “The problem was when we were expected to typewrite unaware of the format. You find that you have the information but don't know how to present it by typing 'cause u can't”. Two students had reservations about the time available and the workload, for example “If we can be given time we can do much better”. While one student expressed a reservation with what the researcher has deduced as competition amongst student peers – “What I would recommend from the staff is to try and explain to students that when we ask questions we not trying to prove others wrong but encourage a thorough research and understanding”. The results of the analysis of positive responses are displayed graphically in Figure 5.

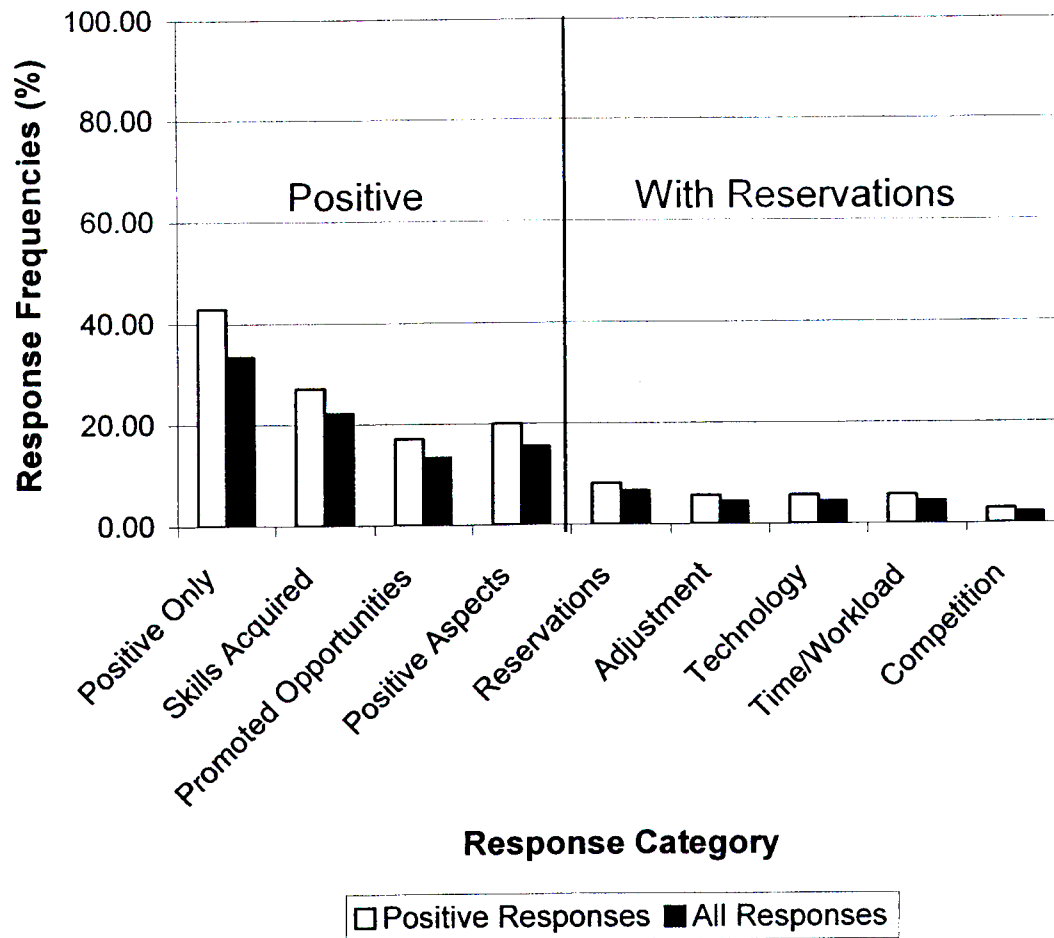


Figure 5: Frequency of positive responses (including positive responses with reservations) into categories as a percentage of the all positive comments (n=35) and as a percentage of total student responses (n=45)

Negative Comments

Of the 4 students who responded negatively to the subject 3 students – representing 6.7% (n=45) of all respondents and 75.0% (n=4) – of all students who responded negatively – were concerned about the approach overall. One obviously embittered response was “Which approach?whose approach?the lecturers try hard to feed us everything and sometimes its hard to swallow everithing!”, while another said simply “The approach was not Good”. One student – representing 2.2% (n=45) of all respondents and 25.0% (n=4) had a problem with the lecturer – “The lecture[r] should have explained what he was going to do or how things are going to be during this course or throughout the course” (see Figure 6).

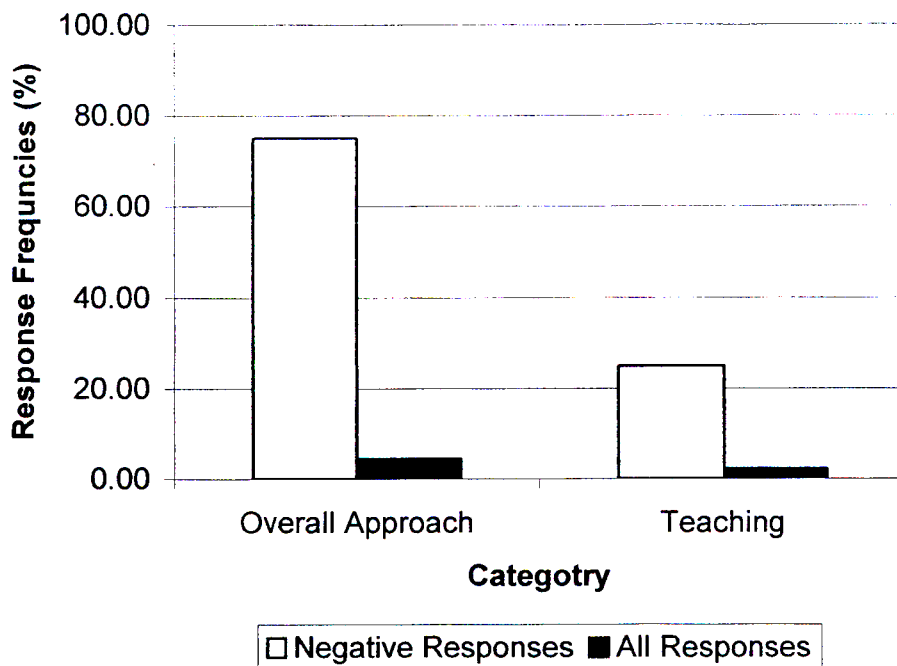


Figure 6: Frequency of negative responses into categories as a percentage of the all positive comments (n=4) and as a percentage of total student responses (n=45)

Neutral Comments

The researcher deemed 2 comments – representing 4.4% (n=45) of all the responses – to be neutral. Both comments can only be described as offering advice, albeit sound advice – “To do well in this subject,you should keep an open mind and have a flair science,mostly biology.Patience and self-motivation are good qualities too in this subject”. and “The lecturer must give us assignment after finishing any chapter”.

4.2 The Effect of the Course on Student Achievement

In this section student achievement is analysed in terms of results obtained in two courses, PLGY232 and PLGY242, in the study year, 2002 and two courses, PLGY232 and PLGY242, in the control year, 2001.

Two paired-samples *t*-tests were undertaken in order to establish the effect of implementation of this course on the academic achievement of the student participants. In the first instance, the mean of the results of students who participated in the same module as the study module, namely PLGY232, in the previous year, 2001, were compared with their mean marks in the following module, namely PLGY242, in the same year, 2001. This would act as the experimental control and 2001 will be referred to in this section as the control year. The same exercise was repeated using data for the same modules, namely PLGY232 and PLGY242, in 2002, the difference being that in 2002 PLGY232 was the module that was partially made up of the course which formed this study. In this section 2002 will be referred to as the study year.

The paired-samples *t*-test procedure was used because this statistical procedure compares the means of two variables, in this case the two modules PLGY232 and PLGY242, computing the differences between values of these variables for each case, testing whether the average differs from 0.

However, before being able to make the above calculations it was necessary to explore the data to ensure that it was suitable for analysis using this tool.

Explorative analysis revealed that in 2001 we were dealing with 46 students who undertook both PLGY232 and PLGY242. In 2002 (study year) 52 students undertook these modules. Obviously, students who did not participate in both modules were removed from the sample, so were students whose names appeared on the list of both modules, but who were either not allocated a mark for one of the modules, or whose mark was zero. Students with a zero mark in either module were removed because it could not be ascertained whether this mark was allocated because that particular student did not write the exam, or whether this was the mark obtained by

the student for the module. The results of the exploratory analysis of the data are presented in Table 10.

Table 10: Exploratory Analysis of Data

Course	Mean	N	Standard Deviation	95% Confidence Interval		Median	Skewness
				Lower	Upper		
Control Year - 2001							
PLGY232	47.91	46	10.371	44.83	50.99	47.00	0.156
PLGY242	59.39	46	12.971	55.54	63.24	61.50	-0.266
Study year - 2002							
PLGY232	50.48	52	9.459	47.85	53.11	50.00	0.190
PLGY242	43.52	52	13.394	39.79	47.25	43.50	-0.504

The mean, or average, is calculated by dividing the sum of the scores by the number of scores, while the median of a set of data values is the middle value once the data set has been arranged in order of its values (numerical order). The median is the middle value of a list of values, i.e. the smallest number such that at least half the numbers in the list are no greater than it.

A skewness value greater than 1 indicates a distribution that differs significantly from a normal, symmetric distribution. The important aspect of the data gleaned from the exploratory analysis is the fact that the skewness figures for each of the groups of data are smaller than 1, indicating distribution and symmetry within reasonable limits making the use of parametric statistical tools possible. This distribution can be seen in Figure 7.

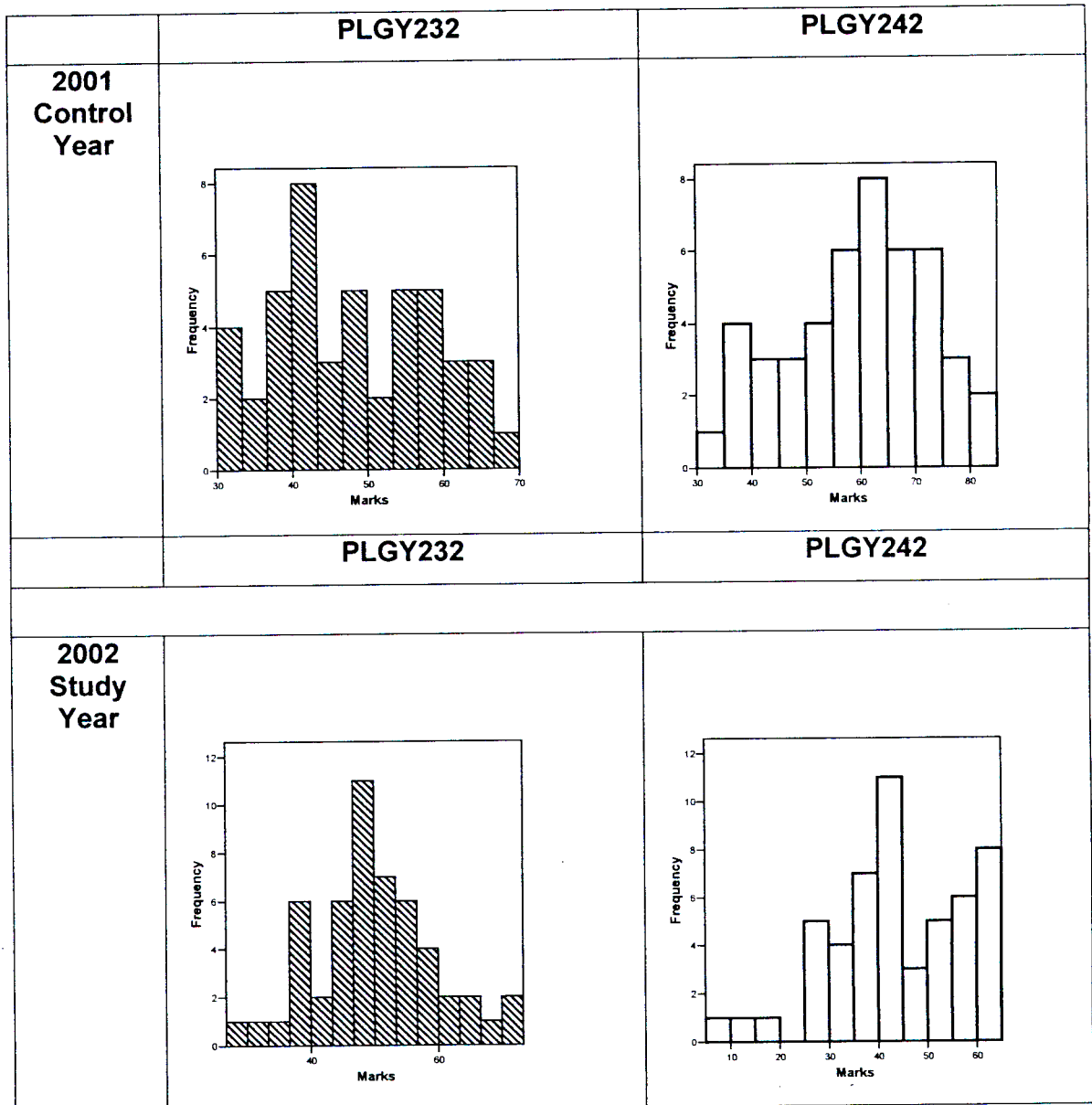


Figure 7: Histograms depicting the distribution of each of the four data sets.

The first indication that the results might reveal that implementation of the course (PLGY232) in 2002 (study year) might have positively impacted on student performance came from the box and whisker plots. Box and whisker plots are statistical tools providing a visual summary of data distribution, resulting from the exploratory analysis of the data. These plots can be seen in Figure 8.

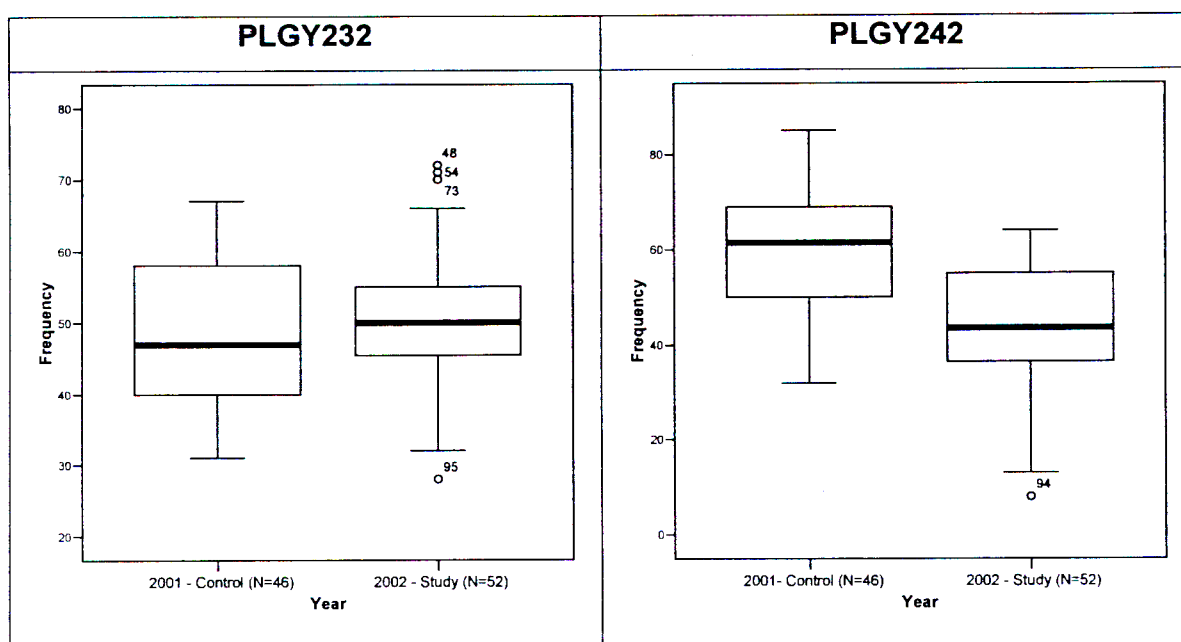


Figure 8: Box and whisker plots

Box and whisker plots are primarily concerned with five summary measures, namely, lowest or minimum value, the first quartile, the median, the third quartile and the highest or maximum value. The bottom of the box represents the extent of the first quartile and refers to the value which exceeds no more than 25% of the data and which is exceeded by no more than 75% of the data. The top of the box represents the third quartile and refers to the value which exceeds no more than 75% of the data and which is exceeded by no more than 25% of the data. The distance between the first and third quartiles, making up the box, is called the interquartile range. The whiskers are the lines extending from the bottom and top of the box to the minimum/maximum value. Outliers, which are values that are much smaller or larger than the majority of observations in a set of data, are indicated in box and whisker plot. The dark line inside the box of the plot marks the median or middle value above which half the data are greater in value and below which half the data are smaller in value.

It is clear in Figure 8 that the median for PLGY232 in 2002 (study year) is slightly higher than the median for PLGY232 in 2001 (control year), in fact, 50.0 and 47.0

respectively. In contrast, the median for PLGY242 in 2001 (control year) is higher than that for PLGY242 in 2002 (study year), in fact 61.5 and 43.5 respectively. The trends observed in the exploratory exercise required further investigation. The exploratory exercise also indicated normal, symmetrical distribution, allowing for the employment of parametric statistical tools. With this in mind, a paired-samples *t*-test was undertaken on the data obtained in 2001 (control year) and for the data obtained in 2002 (study year). The results of this exercise are presented in Table 11.

Table 11: Results of the Paired-Samples *t*-test Undertaken on the Means of Student Performance in modules PLGY232 and PLGY242 in 2001 and in 2002

Table 11a: Paired Samples Statistics

Year			Mean	N	Std. Deviation	Std. Error Mean
Control Year 2001	Pair 1	PLGY232	47.91	46	10.371	1.529
		PLGY242	59.39	46	12.971	1.912
Study Year 2002	Pair 1	PLGY232	50.48	52	9.459	1.312
		PLGY242	43.52	52	13.394	1.857

Table 11b: Paired Samples Correlations

Year			N	Correlation	Sig.
Control Year 2001	Pair 1	PLGY232 & PLGY242	46	.658	.000
Study Year 2002	Pair 1	PLGY232 & PLGY242	52	.689	.000

Table 11c: Paired Samples Test

Year			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
Control Year 2001	Pair 1	PLGY232 - PLGY242	-11.478	9.941	1.466	-14.431	-8.526	-7.831	45	.000
Study Year 2002	Pair 1	PLGY232 - PLGY242	6.962	9.709	1.346	4.258	9.665	5.170	51	.000

It is immediately apparent from Table 11 that the significance values for the comparison of means for both years are less than 0.005, with $p < 0.0001$ in both t-tests. This would indicate that there is a significant difference between the scores that the students obtained for each of the courses considered in both years, 2001 (control year) and 2002 (study year). This is further substantiated by the fact that the 95% confidence interval of the differences does not contain a 0 between the lower and upper values in both instances. However, what is of interest here is the fact that in 2001 (control year) the class performed significantly better in PLGY242, averaging 59.4% ($\pm 13.0\%$), than in PLGY232, averaging 47.91% ($\pm 10.4\%$). In contrast, the class of 2002 (study year) performed significantly better in PLGY232, the module which contained the test course, averaging 50.5% ($\pm 9.5\%$), than they performed in PLGY242, averaging 43.5% ($\pm 13.4\%$), although the difference between the means was not as great in 2002 (study year) (7.0%) as in 2001 (control year) (11.5%). Also of interest is the fact that the class of 2002 (study year) achieved a significantly lower mean score for PLGY242 than did the class of 2001 (control year), while the class of 2002 (study year) managed to improve their performance in PLGY232, the module which contained the test course, over their peers in 2001 (control year).

In both cases, there is a reasonably strong correlation between student performance in one module and their performance in the other with correlation coefficients of 0.658 in 2001 (control year) and 0.689 in 2002 (study year). Since the two variables represent the same group of students at different times of the year, it would be expected that correlation between their performances should be fairly high.

The implications of these results in the context of the study will be discussed in the next section, Chapter 5: Discussion.

Chapter 5: Discussion

This study set out to redesign a second (final) year course in Physiology at the University of the North using constructivist philosophy as a guide and computer- and World Wide Web-based technologies in support of its implementation. Before discussing the results it is perhaps pertinent at this stage to look at the course itself in order to establish whether, in fact, it met all the requirements set out in Chapter 3: Theoretical Framework.

5.1 The Course in Relation to the Theoretical Framework

There were two primary requirements that the development of this course had to adhere to. In the first instance the course had to be designed in terms of constructivist principles and in the second instance the medium of implementation or presentation, namely computer- and World Wide Web-based, had to conform to the best practices for such mediation in constructivist learning environments.

In the following two sections these two aspects of the study will be discussed.

5.1.1 The Course and Constructivist Pedagogy

There are two important aspects to be considered in this section, namely, did the course subscribe to constructivist pedagogical principles in general and did the course meet Herrington and Oliver's (2000) requirements for authentic learning environments set out in Chapter 2: Theoretical Framework?

5.1.1.1 *Course Analysis in Terms of Reeves' (1997) Pedagogical Dimensions*

Reeves' (1997:online) 14 pedagogical dimensions were used as an instrument to establish the pedagogic credentials of the course.

1. **Epistemology** – according to Reeves (1997:online), objectivist designers are concerned with presenting knowledge as the ultimate truth within their field of expertise. Constructivists, on the other hand, will attempt to present multiple perspectives, affording students the opportunity to construct their own knowledge. It is the author's contention that this study leans towards constructivist epistemology as students were given the opportunity to examine the issues surrounding the tasks set, with some coaching and scaffolding provided through the opportunities provided for discussion and reflection.
2. **Pedagogical Philosophy** – according to Reeves (1997:online), goals and objectives are an important characteristics of instructivist learning environments, with learning sequenced from lower to higher order learning, and direct instruction designed to meet the objectives and learners considered empty vessels to be filled with knowledge. On the other hand, constructivists will strive to develop rich learning environments, recognising the unique nature of each learner's "interests, styles, motivations and capabilities". In the context of this study an attempt was made to provide a rich learning environment based on the concept of discovery learning in an authentic learning environment. However, the design of the course falls short with respect to considering the "interests, styles, motivations and capabilities" of individual learners and the tailoring of the learning environment to meet their needs. Having said that, nothing was done to enforce a particular approach onto the individual learners or onto the groups. Learners and group dynamics were left to develop strategies as they saw fit in order to accomplish the tasks at hand.
3. **Underlying Psychology** – according to Reeves (1997:online), behaviourists are concerned with shaping behaviour through cycles stimulus, response, feedback and reinforcement. Cognitivists are more concerned with internal mental activities and the employment of a number of learning strategies in order to promote inductive and deductive learning. It could be argued that there was a degree of the cyclical stimulus, response, feedback and reinforcement in the way this course was presented. However, the aim was to develop the sort of taxonomy that Reeves (1997:online) talks about which

leads to the development of the mental models so important in the development of “generalizable problem solving abilities” that Reeves (1997:online) deems desirable.

4. **Goal Orientation** – Reeves (1997:online) distinguishes between sharply focussed goals, requiring the memorisation of vast amounts of facts, and unfocussed goals, where it is recognised that knowledge is tenuous and creative. This course certainly did not require the memorisation of facts. The goals of this course were multifold. The acquisition of skills and knowledge was an important aspect of this course. However, equally important was the acquisition of skills and knowledge in a variety of domains, as evidenced by the importance of the generic outcomes required by the South African Qualifications Authority in the context of this course.
5. **Experiential Validity** – Reeves (1997:online) highlights the principle of transferability of classroom learning to real life as important. In instructivist classrooms it is left to the learners to develop the links between what they learn in the classroom to what they experience in the real world. Constructivist classrooms, according to Reeves (1997:online) should focus on the construction of “useful” rather than “inert” knowledge. In the context of this course, an attempt was made in the structure of the tasks in such a way as to show students that the physiology that they learned has application in the outside world.
6. **Teacher Role** – in traditional classrooms, according to Reeves (1997:online), the role of the teacher is didactic. In other words the teacher spends most of the contact time talking to students, providing authoritative knowledge about the subject domain. In constructivist classrooms, the role of the teacher is one of a facilitator. This was certainly true of the course implemented in this study. The teacher played an important role in guiding the class through participation in the formative assessment process and participation as an expert panellist during the presentations, contributing to the process of construction of knowledge that the students went through. The teacher never played a didactic role at any time.

7. **Flexibility** – Reeves (1997:online) warns that the issue of flexibility is complex and that online learning environments:

... must be designed to walk the fine line between being so "teacher-proof" that they do not allow local adaptation (and may even encourage sabotage) and being so open or unstructured that they do not provide sufficient guidance and support for valid implementation.

The approach taken during the implementation of this course is deemed to have been sufficiently flexible to meet the requirements of constructivist learning environments. While the process of implementation was not completely unstructured, it was also not rigidly structured. Implementation could not have taken place in the absence of the teacher, but the teacher's role was one of a participant within the community of learners – albeit in his capacity as subject-matter expert, rather than as a leader of a group.

8. **Value of Errors** – Reeves (1997:online) reminds us that experiential learning is a valuable form of learning as it provides opportunities for students to learn from their mistakes. There was certainly an element of this in the course as the formative assessment process was designed in such a way that students could present their ideas, which were then subjected to assessment by the rest of the class and by the "expert" participants in the course. Groups were then afforded the opportunity to "correct" these errors as they saw fit, by returning to their sources of information in order to understand where they went "wrong".
9. **Origin of Motivation** – Reeves (1997) points out that intrinsically motivating learning environments are difficult to achieve. As will be seen on the section in this chapter dealing with the researcher's journal, the students put an inordinate amount of effort into the course, which can only be ascribed to intrinsic motivation.
10. **Accommodation of Individual Differences** – in order to accommodate individual differences learning environments should, according to Reeves (1997:online), "provide scaffolding, cognitive bootstrapping and other types of metacognitive support". In order to accommodate individual differences students had open access to the lecturers, the researcher and the three

graduates who played the role of teaching assistants. Support was also forthcoming through the formative assessment process, which allowed for misconceptions to be dealt with. While the approach taken by this course emphasised group work, individuals were certainly accommodated.

11. **Learner Control** – according to Reeves (1997:online) learner control is about the degree to which students are allowed by the structure of the course to control their actions and decision-making processes. In this course students were given complete freedom with respect to the directions they would take in accomplishing the tasks set.
12. **User Activity** – Reeves (1997:online) distinguishes between generative and mathemagenic learning environments, with the former being informed by instructivist pedagogy and the latter by constructivist pedagogy. Participants in this course were involved in “creating, elaborating or representing knowledge” (Reeves, 1997:online) in the completion of their tasks, i.e. they were involved in mathemagenic activities.
13. **Cooperative Learning** – according to Reeves (1997:online) cooperative learning involves learners working together in small groups. Group work in completion of the tasks set in this course was central to the course.
14. **Cultural Sensitivity** – Reeves (1997:online) points out that cultural sensitivity is an aspect of course design that is more often than not ignored. This dimension poses an interesting conundrum which, by the way, is not only limited to the development of courses in education, but one that the whole nation struggles with on a daily basis with respect for the provisions of our Constitution. As noted at the beginning of this document, by far the majority of students at the University of the North are black South Africans, most of whom come from a rural background. Rural backgrounds are, by their nature, very traditional and in South Africa that equates to authoritarian and paternalistic society. This situation is further compounded by the educational tradition in schools in rural areas (although not limited to rural areas) where the approach to learning is both traditional (instructivist) and authoritarian.

However, South Africa has a Constitution that, amongst other things, promotes equality of all regardless of race, creed or gender and, in the opinion of this author, this country lives that constitution, at least on a political, administrative and judicial level, which creates tensions between traditional norms and values and so-called “modern” norms and values. There is potential for tensions to develop in an education environment, particularly in a course such as this, where the approach flies in the face of everything that the students participating in the course have experienced, both in their home environment and in their schooling to date. However, South Africa boasts one of the most vibrant and modern economies on the African continent, which is subject to the same demands and pressures that “modern” economies all over the world are subject to, namely the demand for skilled knowledge workers. This demand that cannot be satisfied if, in the opinion of this researcher, the education system continues to be supported by an education system that was designed to develop people with skills and knowledge in support of a different economy. This tension is reflected in the design of this course, where students were expected to actively participate in the course, actively engaging with the learning material, where the expression of their opinions was not only important, but integral to the learning process. In short, many aspects of the course were, by the very nature of the course, culturally insensitive and rightly so. Having said that, every effort was made to ensure that the environment in which the students participated was a safe one.

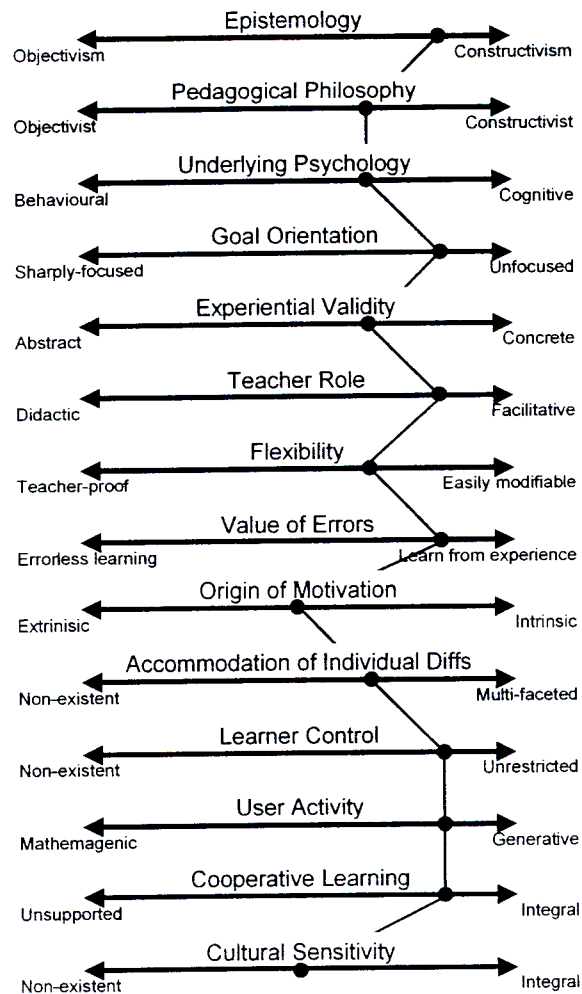


Figure 9: Application of Reeves' (1997) pedagogical dimensions to the course that forms the subject of this study.

It would appear from the author's analysis of the course in terms of Reeves' (1997:online) pedagogical dimensions (Figure 9) that this course went a long way in meeting the requirements of constructivist pedagogical principles. Areas that need more consideration in the design of future courses of this nature include that part of Pedagogical Philosophy that deals with "interests, styles, motivations and capabilities" (Reeves, 1997:online); Experiential Validity, particularly in terms of the nature of tasks set; the Origin of Motivation, which would require more attention in the design phase as little conscious consideration was given to this important aspect of course design; and Cultural Sensitivity, although the conundrum surrounding this dimension was dealt with in depth (see point 14 above).

5.1.1.2 *Course Analysis in Terms of Herrington and Oliver's (2002) Requirements of Authentic Learning Environments*

As discussed in Chapter 3: Theoretical Framework, Herrington and Oliver (2000) list nine requirements for constructivist authentic learning environments. Each of these requirements will be dealt with in terms of the course that formed the subject of this study.

1. Authentic learning environments must provide authentic contexts that reflect the way knowledge will be used in real life.

An attempt was made to present the course to students in an authentic context. Practitioners in the field are going to have to work collaboratively in order to solve problems by drawing on the existing body of knowledge, synthesising their findings before presenting them to their peers and others and be able to defend their assertions based on the input from those around them. However, the course in which the students participated fell short of complete authenticity because of the nature of the tasks that students were required to undertake. These tasks were little more authentic than the traditional tasks learners are subjected to in Mathematics, for example, which begin "A train travelling . . .". So, while the activities undertaken by students in completing the tasks could be classified as authentic, the tasks themselves need to be reconsidered – perhaps the case-study approach would be more appropriate.

2. Provide authentic activities

As mentioned above, the activities that students had to undertake in order to complete the tasks were reasonably authentic, even if the tasks themselves fell short of that classification. This is certainly an area that needs attention in future.

3. Provide access to expert performances and the modelling of processes

Access to expert performance and modelling was provided in that subject specialists in the form of lecturers and graduate students participated in the formative assessment process. Furthermore, students had to present their findings to a panel of their peers and the subject experts just mentioned. However, it is recommended that, with the creation of more authentic tasks, students should also have access to expert practitioners and that practitioners should be invited to participate in the course along with the subject experts mentioned.

4. Provide multiple roles and perspectives

Multiple roles and perspectives were provided to the extent that two groups undertook each task, each group approaching the accomplishment of the tasks from different angles. In the formative assessment process and in the presentations, debate and discussion was encouraged. To a large degree this requirement was fulfilled.

5. Support collaborative construction of knowledge

This requirement was definitely fulfilled as group and collaborative work was key to successful completion of the tasks.

6. Provide reflection to enable abstraction to be formed

The course design certainly allowed for reflection and reconsideration of positions taken by the students. Whether this led to any form of abstraction is difficult to determine. A future approach may be to present different tasks dealing with the same principle, so that students are consciously made aware of the fact that knowledge can be transferred across situations.

7. Provide articulation to enable tacit knowledge to be made explicit

Students were given the opportunity to present their understanding of the subject matter at hand in many ways. Firstly, students submitted work for formative and summative assessment. Secondly, students had to present their findings orally and field questions from the floor regarding these findings. Finally, students had to comment on the submissions of their peers, which required of them to draw on their own understanding in order to make a meaningful contribution to this process.

8. Provide coaching and scaffolding by the teacher at critical times

Coaching and scaffolding was available at all times. Students had access to the teaching assistant who were physiology graduates and who had participated in an online course themselves during the course of their post-graduate studies. As a result both subject matter and technology experts were on hand to assist. Furthermore, students were encouraged to make use of the discussion forums to questions, and to answer questions posed by others.

9. Provide for authentic assessment of learning within the tasks

In a sense assessment was authentic. Formative assessment allowed participants to present their ideas for discussion and then modify their ideas based on the outcomes of the discussion. Students had to present their ideas orally and then defend their ideas against criticism from the audience, which included their peers and subject matter experts. Students also had to assess the contribution of their peers to the group effort.

When measured against Herrington and Oliver's (2000) requirements for authentic learning environments the course that formed the subject of this study appears to come up trumps. It is the opinion of this researcher that the course meets the requirements for authentic learning environments in almost every aspect. However, it is acknowledged that the course did fall short in some areas and attention should be

given to rectifying this in the future, particularly with respect to the tasks themselves (see point 1 above).

5.1.2 The Course and Technology Mediation

In Section 2.4.2: Computer-mediated Learning Environments, best practices with respect to the use of computer- and World Wide Web-based technologies in constructivist learning environments were identified. The question now is whether the course implemented as part of this study measured up to these practices.

1. Collaboration

Not only was the approach to the course one of collaboration amongst students in their respective groups. Technology allowed for the development of a learning environment where such collaboration could take place. Forums were set up where students could not only interact with group members but with the whole class, including non-student participants in the course in order to accomplish their tasks. Furthermore, a number of resources were made available to students via the World Wide Web. These resources included subject matter material as well as support material such as access to websites dealing with the use of technology components (e.g. MS Word and MS PowerPoint), websites dealing with public speaking and the preparation of presentations and sites dealing with students in an online environment.

2. Communication

The course boasted communication tools in the form of email and the discussion forums mentioned above. Students were encouraged to use these tools in order to accomplish their tasks. For example, students could only receive assistance from lecturers through the discussion forums. Questions of both an academic and administrative nature were posted in the forums made available for this purpose and answered there so that the class as a whole had the benefit of accessing these answers.

3. Interaction

Technology-mediated interaction was key to the success of this course. Students interacted with each other on various levels, particularly during the formative assessment process when groups commented on each other's submissions, which stimulated debates amongst the groups centred around these comments. Students interacted with the course content online in a number of ways in order to complete their tasks and in order to assess the tasks of other groups. Student interaction with subject matter experts was also facilitated by technology.

4. Rich Learning Environment and the Learner as Producer of Knowledge

Computer- and World Wide Web-based technologies afforded an opportunity to create a community of learning in which the learners were seen as producers, as opposed to consumers, of knowledge, with technology facilitating the process. While it is certainly possible for this course to have been undertaken without technology mediation it is likely that the environment would not have been as rich as it turned out to be without the assistance of technology.

In this section the course that formed the subject of this study was measured against Reeves' (1997) pedagogical dimensions and Herrington and Oliver's (2000) requirements for authentic learning environments and appears to fulfil most of the requirements of constructivist informed authentic learning environments, although aspects of the course did fall short of these requirements. The course was also measured against requirements for best practice with respect to computer mediation. What is now required is to look at what the students felt about this course, particularly in light of the issues raised in Section 1.1: Background.

5.2 Student Perceptions of the Course

In this section I will deal with the results obtained from the Student Evaluation Questionnaire which the students completed at the end of the course. These results are presented in Section 4.1: Student Perceptions of the Course.

5.2.1 Quantitative Analysis of Student Perceptions

Table 6 in Section 4.1.1: Analysis of Categorical Data Collected from the Subject Evaluation Questionnaire, present the results of the quantitative analysis of the Student Evaluation Questionnaire (see Table 4 in Section 3.2.1: Subject Evaluation Questionnaire). The questionnaire was a modified version of the Course Evaluation Questionnaire, developed by Ramsden (1992) and implemented annually in Australia. The Subject Evaluation Questionnaire was developed by the University of Technology, Sydney, Australia and was chosen as an instrument for this study because it emphasises generic skills as opposed to independence. The questionnaire was designed to evaluate student perceptions of courses in particular categories and questions are classified according to category (see Section 3.2.1: Subject Evaluation Questionnaire). A 7-point scale was used with 3 being the non-committed response. What is pleasing when consulting Table 6 is the fact that, even taking standard deviation into account, none of the means fall below 3, the “average”, and only in two categories, namely “Workload” and “Assessment”, did individual responses fall below this benchmark.

The following was found when considering student perceptions of the categories that the questionnaire was designed to measures (see Table 5 in Section 4.1.1).

1. Good Teaching

The mean of student responses to questions in this category was 5.5 ± 0.7 , which falls midway between “Strongly Agree” and “Agree” on the 7-point scale, with the minimum being 3.5 and the maximum 6.7. This would indicate that the students perceived the teaching of this course very positively, which is interesting given the background of the students which has been continually alluded to throughout this document. It shows that, despite the fact that students are more accustomed to a didactic and authoritarian approach to education, they were able to adapt to an approach that put them at the centre of the learning process. Not merely adapt, the results of the evaluation of this category would indicate that the group thoroughly enjoyed themselves.

2. Goals and Standards

The mean of student responses to questions in this category was 5.0 ± 0.7 , which falls within “Strongly Agree” on the 7-point scale, with the minimum mean being 3.3 and the maximum 6.5. This would indicate that the students perceived the teaching of this course very positively. This result indicates that the course was very clear about what was expected of the students. While constructivist learning environments often lack structure, it is important that students know what is expected of them in the end and it appears as if this was achieved in the design of this course.

3. Workload

The mean of student responses to questions in this category was 4.1 ± 0.8 , which falls within “Uncertain” on the 7-point scale, with the minimum mean being 2.5 and the maximum 5.5. This indicates a potential problem with regard to student perceptions of the workload. Certainly the new approach and the fact that students had also to deal with a medium that they were not familiar with would have had something to do with this and the employment of technology probably added to their cognitive load. As will be seen later in this chapter (Sections 5.2.2: Qualitative Analysis of Student Perceptions and 5.3: The Researcher’s Reflective Journal and Student Perceptions) students put an enormous amount of effort into the completion of these tasks and certainly some of that effort was as a result of the technology involved. Having said that, students appeared to willingly put in that extra effort and it seems that student perceptions with respect to workload did not have a detrimental effect on their overall perception of the course (see point 6).

4. Assessment

The mean of student responses to questions in this category was 3.8 ± 0.7 , which falls between “Uncertain” and “Disagree” on the 7-point scale – although closer to “Uncertain”, with the minimum mean being 2.3 and the maximum 5.0. The results of this section indicate that students had a degree of difficulty with the assessment approach of this course. As will be seen later in the chapter (Sections 5.2.2: Qualitative Analysis of Student Perceptions and 5.3: The Researcher’s Reflective

Journal and Student Perceptions) there was some resistance to the peer assessment approach borne out of a misunderstanding on the part of the students. This misunderstanding was only cleared up after the completion of the questionnaire. Be that as it may, peer assessment is something new to students at this institution; certainly participants in this study had never participated in peer assessment prior to this study. While student perception of the assessment approach taken in this course was not positive, it seems that assessment did not detract of the overall perceptions about the course (see point 6).

5. Generic Skills

The mean of student responses to questions in this category was 5.7 ± 0.7 , which falls within “Agree” to “Strongly Agree” on the 7-point scale, with the minimum mean being 3.8 and the maximum 7. As we will also see later in this chapter (Sections 5.2.2: Qualitative Analysis of Student Perceptions) students felt that they had gained a number of generic skills. Not surprisingly a number of comments made by students were related to technology. However, a number of students commented about other skills, such as critical thinking skills and working in groups. Given the importance of the generic outcomes of the National Qualifications Framework in the design of this course, the results of student perceptions in this section is pleasing.

6. Overall Assessment

The mean of student responses to questions in this category was the highest of any category, 5.8 ± 0.8 , which falls within “Highly” and “Average” on the 7-point scale, with the minimum mean being 4.0 and the maximum 7. Despite the problems with workload (see point 3) and assessment (see point 4), students rated this course highly. So it would appear that, despite the reservations expressed early on in this document with respect to the experiences of the students in terms of their educational background, perceptions of the students participating in this course were very positive towards both the subject itself and the approach taken by this course. This is an extremely pleasing outcome, although attention will have to be given to the two areas that students were not so positive about.

Although not part of this study in terms of the research questions that this study attempted to answer, it was decided to test whether there was a correlation between student perceptions of the course and their performance. This was done in light of the fact that much of the literature discusses correlations between these two parameters, or lack thereof. In testing the data for suitability for this calculation it was found that there was no evidence of a linear relationship between the sets of data, indicating that the data was not suitable for the correlation calculation.

5.2.2 Qualitative Analysis of Student Perceptions

The results of the qualitative data analysis of the responses of the students to the open-ended sections of the questionnaire were presented in Section 4.1.3: Qualitative Data Analysis of Student Perceptions. The open-ended sections were added to the questionnaire in order to give the participants an opportunity to expand on their responses to the questionnaire and to give the researcher more in-depth information on student perceptions.

The responses by the students in both open-ended submissions were overwhelmingly positive, 82.2% in the case of Submission 1 and 77.8% in the case of Submission 2, a further indication that the student perceptions of the course were extremely positive. However, it was the responses that students made which went further than merely endorsing the course that were most insightful, positive, negative and neutral.

One of the problems identified by the researcher with respect to the open-ended questions was that students who completed the questionnaire had difficulty distinguishing between what was required of each of the statements. On reflection, these two statements were badly worded. What the researcher was trying to do was distinguish between the constructivist approach to the course and the technology involved in the mediation of the course. This certainly weakened the result obtained from this exercise. In the discussion of these open-ended statements no distinction will be made between the two statements and each comment will be taken on its own merits and discussed as such. Student responses included the following (please

note that none of the comments have been edited for either spelling or grammatical errors):

I think it very advisable for the staff to continue doing things this way.

This method should be used in every module.

I wish some of the lecturers can use the system that we have been using in this subject.

Firstly it was hard for me but i realise that nothing is impossible.

After this we will feel that we are learning.

Nothing like this has ever been done in this course, so the approach was actually good and the deliverance was understandable.

It encouraged us to link what we have learned previously with the present work.

because you can in your own time follow the work done in class.

These responses go to the very heart of this study, indicating that these students, in particular, saw the value of the approach to the subject and extending that approach to other subjects in which they were involved. The last comment is particularly interesting in that this student saw the need to draw on what had been previously learned, both in other sections of the second year course, and in previous years, in order to complete the tasks.

There were three negative comments received with respect to the teaching approach:

The lecture should improve his teaching method in order to improve the overall percentage mark of this course.

Which approach?whose approach?the lecturers try hard to feed us everything and sometimes it is hard to swallow everything!

The lecture should have explained what he was going to do or how things are going to be during this course or throughout this course.

&the way practicals were conducted.About practicals,it was totally not good to perform a pract without

These comments indicate that some students experienced difficulty with the approach to the course and cognizance should be taken of this fact. However, these comments were counterbalanced by a very positive comment in this regard:

The staff was dedicated in helping us in learning more about this course.

Issues surrounding the implementation of the course are also discussed in the next section (Section 5.3: The Researcher's Reflective Journal and Student Perceptions).

This course helped us not to be shy of express our feelings to our mates.

This response indicates to the researcher that this student benefited from the sense of community that constructivist learning environments, if designed properly, can engender. This is an extremely interesting comment in light of the educational background of the students at this institution where silent participation in courses is the norm and little, if any, interaction takes place between the learners.

It developed our critical thinking.

It deals with postgraduate method of study.

The more we work under pressure, is the more we learn.

. . . extending my knowledge . . .

It needs understanding not memorising.

To do well in this subject, you should keep an open mind and have a flair for science, mostly biology.

The comments are interesting in that these student participants in the course appear to recognise that the approach to this subject had greater academic worth with respect to their subject. In the opinion of this researcher this indicates an acknowledgment by these students that the learning environment was more meaningful than learning environments that they usually experience. The last quote is particularly pleasing as it indicates to this researcher a realisation on the part of this student that understanding is more important than memorising.

However, two students did express reservations about the support received during the course:

More effort need to be put on helping students with difficulties on this course.

What I would recommend from the staff is to try and explain to students that when we ask questions we not trying to prove others wrong but encourage a thoroughly research and understanding.

There were some issues regarding participation of students in the discussions after presentations by the groups, some of the students in the audience tried to score points against their peers by making derogatory comments, a practice which was quickly stopped by the course facilitator.

Some comments reinforce the observations made in the previous section (Section 5.2.1: Quantitative Analysis of Student Perceptions) with respect to workload (Section 5.2.1: Quantitative Analysis of Student Perceptions, point 3) and assessment (Section 5.2.1: Quantitative Analysis of Student Perceptions, point 4):

... spending much time on the computer ...

Time given to the modules is very little and makes it hard to grab up everything bearing in mind that we have other courses at hand!!!the load is too much.

These comments indicate that workload was an issue amongst some of the students. This issue will also be addressed in Section 5.3: The Researcher's Reflective Journal and Student Perceptions.

We should have been given quiz as away of testing our understanding.

The lecturer must give us assignment after finishing any chapter.

The problems are: the methodology used for assessments was "BAD" (not settling).

If we can be given time we can do much better.

The problem is to accessing by other student, b'cos student have more problem among they are self will give insufficient marks rather than any lecture of physiology will give the marks you have.

Both these comments are indicative of the problem students had with the approach to assessment taken in this course. This issue is also addressed in Section 5.3: The Researcher's Reflective Journal and Student Perceptions, and is certainly an issue that will need to be addressed in courses that utilise this approach to assessment in the future.

I suggest that you gave each individual a task to do so that you evaluate their ability and capabilities based on the subject. Because some of use would like to persuade it as one of our majors.

This student had a problem with group work. Interestingly enough this was the only comment that alluded to group work directly, either positive or negative, which would, in the opinion of this researcher, indicate that the students accepted the group approach without giving it a second thought.

In terms of technology, students who participated in the questionnaire had the following to say:

It has opened my eyes in the world of computers(internet)!!

If missed classes you had a chance to go to the computer and check lecture notes.

this course taught me and a lot of my friends so much on computers. I always took computers for granted, but not until I started with this course. There are a lot of things that I learned about computers, apart from this course- like using e-mail's and brow[ser].

The problem was when we were expected to typewrite unaware of the format. You find that you have the information but don't know how to present it by typing 'cause u can't.

i wish more time will be provided on learning how to use the computer because other things like formatting of the presentation even now it is not clearly captured.

The comments indicated that generally the technology was favourably perceived, but that there were some issues surrounding the use of technology and the amount of training students received in the use of technology.

All in all the comments received from the students who responded to the questionnaire reinforced the findings of the quantitative analysis of the questionnaire. Generally students perceived the course in a positive light, but there are certain issues that need to be reconsidered before implementation in future.

5.3 The Researcher's Reflective Journal and Student Perceptions

A number of entries in the researcher's reflective journal have bearing on this discussion regarding student perceptions of the course.

After spending a large part of the first contact session with the students explaining the approach to the course and what they needed to do, I paused to look at the group and saw what I described as a "sea of blank faces". I noted that as the students began to divide themselves into groups that there appeared to be an enormous amount of confusion about what had to be done and, frankly, I recorded that I thought that I had "bitten off more than I could chew". I was obviously concerned about the success of the project. At the beginning of the second contact

session approximately 13 new students arrived to start the course, students who had not attended the first session, and time was spent getting this group up to speed. This could possibly account for the comment in the previous section relating to lack of explanation regarding the course approach documented in Section 5.2.2: Qualitative Analysis of Student Perceptions.

The second session was a “hive of activity” and when I left the classroom at 5pm after having been with the students for three hours, almost every student was still busy working on their task. I noted in my journal that the following day the students employed as teaching assistants informed me that most of the students were still there at 10pm when the computer laboratory closed, which meant that they had been at it for about 8 hours. I noted this as a concern in my journal, fearing that either the workload or interaction with technology, or both, were resulting in the students putting in more effort than they had planned for and that they would be resentful of the fact. At the beginning of the next contact session I called together the group leaders to consult them on this issue. The group leaders were unanimous in their comments on the issue, the group members were putting in so much time because they were enjoying what they were doing. Obviously from some of the comments received as a result of the questionnaire does not wholly bear this out, nor do the results of the qualitative assessment of the questionnaire responses. However, it would appear from the analysis of the results of the questionnaire that, while the course did involve a great deal of work on the part of the students, they undertook the work willingly for the most part.

Another area of concern with respect to student perceptions of the course, namely the assessment approach, also found its way into my reflective journal. The questionnaire was made available to the students before the end of the course, and closed just before the beginning of the final contact session I had with the students, which marked the end of the course. While the final presentations were being made, I did a rough calculation of the responses to the questionnaire in MS Excel and created a chart, which I then downloaded to the course web site and made available to the students. I noticed that assessment was a particular cause of concern and approached the students at the end of the session to see if I could establish the cause of the problem. In this discussion it soon became apparent that the students

had misunderstood the role of their involvement in the assessment process. It appeared that the students thought that their contribution to the assessment process was the only contribution that would be considered for the final mark, hence the comment by one of the student respondents to the questionnaire regarding the problem with assessment and sufficient marks documented in the previous section. I took the opportunity to explain to the students exactly how the assessment process worked, which seemed to satisfy them. This misunderstanding may account for the poor student perceptions of Assessment category, both in the qualitative and quantitative analysis.

Having said this, it is interesting to note that I made reference in my journal to the fact that students appeared to take their roles in the assessment process very seriously. Student participation in the formative assessment process was, for the most part, well thought out, however the students knew that their participation would be assessed, so this is not surprising. However, I made a note in my journal to the effect that I came across very few situations where, in my opinion, students did not take the peer assessment process seriously, by this I mean giving all or some of their peers full marks, or no marks at all, for their contribution to the group (unless of course the whole group felt the same way about the contributions of a particular individual).

The research approach would have benefited from a series of interviews during which time problems identified in as a result of responses to the open-ended statements could have been investigated in more depth.

5.4. Student Perceptions and the Research Questions

Four of the five research questions are pertinent to this section.

Research Question 1

How did the implementation of a constructivist-informed, computer-mediated course in a second (final) year course in the discipline of Physiology at the University of the North, with particular emphasis on the development of an authentic learning

environment in the cognitive apprenticeship tradition, enhance the worth of the course in the eyes of the learners participating in the course?

As pointed out in Section 1.4: Research Questions, in order to measure whether an intervention of this nature enhances the worth of the course in the eyes of the participants it is necessary to have base data from which to work. In other words, some information regarding student perceptions of the course as it was presented previously would need to be compared to student perception data acquired as a result of this study. As mentioned at the beginning of this document, in Section 1.4: Research Questions, this study represented the first of its kind at the University of the North, so no such historical data exists. It is therefore impossible to determine whether student perceptions of this course were any different from student perceptions of the course that this course replaced. From the data, both quantitative and qualitative, it is safe to say that the student perception of the course was positive. Comments received from students as a result of responses to the open-ended statements of the questionnaire, namely:

- I think it very advisable for the staff to continue doing things this way.
- This method should be used in every module.
- I wish some of the lecturers can use the system that we have been using in this subject.
- Nothing like this has ever been done in this course, so the approach was actually good and the deliverance was understandable.

seem to indicate that the worth of this course was enhanced in the eyes of the students. However, these three comments do not represent sufficient evidence for this researcher to say categorically that the worth of the course was enhanced in the eyes of the students. Certainly this is an area that requires attention in the development of future research projects of this nature.

Research Question 2

How did the students participating in the course experience the computer mediation?

There is little direct evidence from the results captured during this study of student experience with computer mediation. The three comments received from the students in this regard indicate a mixed reaction:

- It has opened my eyes in the world of computers(internet)!!

- If missed classes you had a chance to go to the computer and check lecture notes.
- The problem was when we were expected to typewrite unaware of the format. You find that you have the information but don't know how to present it by typing 'cause u can't.

However, the positive manner in which this course was perceived by students overall is an indication that computer mediation posed little problem to the students. It is interesting that in the researcher's reflective journal mention is made of the fact that many academics warned the researcher of impending disaster if computer mediation was to be used because of the limited technological experience of the students. This warning was not lost on the researcher, given the background of students at this institution, as discussed in Section 1.4: Research Questions. For this reason, teaching assistants with technology experience, experience with the format of presentation of this course and with a physiology background were employed as teaching assistants. Their role was critical to the success of this project, and it is obvious from the results that they played it well. Certainly technology issues could pose a problem but, as long as provision is made to support the students in this environment, the problem can be overcome. In answer to this research question, this researcher believes that the students did not experience technology either in a positive or negative light, they experienced it as part of the whole that comprised this course, which is as it should be.

Research Question 3

How did the students participating in this course experience the approach?

The overwhelmingly positive response from students both as far as the quantitative and qualitative analysis of the data is concerned would indicate that the students relished the opportunity. Apart from the comments listed in answering the first research question above, comments such as:

- It developed our critical thinking.
- It deals with postgraduate method of study.
- The more we work under pressure, is the more we learn.
- . . . extending my knowledge . . .
- It needs understanding not memorising.

- To do well in this subject, you should keep an open mind and have a flair for science, mostly biology.

are indicative of the positive effect the course approach had on the students. In the opinion of this researcher, the students experienced this computer-mediated, constructivist-informed course positively. This is very pleasing in light of the educational and technology poor background from which the students who participated in this course come.

5.5. Research Question 4

Research Question 4

What issues arising from the implementation of this course would need to be addressed in order to improve the chances of success in future courses of similar design and approach?

It is immediately obvious from the qualitative and quantitative analysis of the questionnaire responses of student participants in the course that the students had issues with both the workload and the format of assessment. While these issues did not appear to impact on overall student perception of the course, they do need to be addressed in the future, even if it means explaining the course requirements to the students more carefully.

Assessment, and the problems associated with assessment appear to have arisen from a misconception about their role in the process. The students seemed to think that their contribution to the assessment process was the only assessment that was taking place. This issue was discussed in Section 5.3: The Researcher's Reflective Journal and Student Perceptions. Certainly it is important that students play a greater role in developing assessment practices and this would be an area that would have to be given more attention in the future.

Negative student attitudes towards workload are not a new phenomenon and certainly not confined to online courses. However, if, as discussed in Section 2.1:

Learning and the Literature, the object of the exercise in a constructivist course is the promotion on deep learning strategies, then, as Chambers (1992:154) points out:

... it implies that teachers may actually need to restrict the scope of a curriculum, especially in the early stages of students' careers, in order to make the time and provide incentives for them to behave appropriately; to think; go back over things; work towards the broader frame and context from and within which to make their own meanings (individually and in group settings; experiment with their writing; and come to understanding of how important it is that they begin to find their own 'voice' within these discourses. If students do not have time to do these things, if they are always driven on by the demands of the curriculum, we leave them little choice but to skim along on the 'surface' of things, merely echoing their teachers' voices".

This is further complicated by the fact that the students in this course had not only to contend with the demands of the curriculum, they also had to contend with a new approach of a constructivist learning environment and they had to deal with technology, both for the first time in their learning careers. This issue has institutional implications. In particular, student computer literacy is something that needs to be addressed at an institutional level in order to prepare students for technology mediation in the curriculum. It is interesting that the bridging year at the University of the North, UNIFY, exposes students to constructivist learning right from the onset of their career. However, only a small number of students relative to the first-year intake are drafted into this programme.

5.6 Student Performance

Student performance in 2002, the year in which this course was implemented as part of PLGY232 was compared with student performance in 2001. The results of this comparison can be found in Section 4.2: The Effect of the Course on Student Achievement. In order to measure the effect of the course on student achievement student performance in PLGY232 was compared to student performance in the following module PLGY242 and the results of this comparison compared. At the outset of the project it was envisaged that this comparison would involve rigorous qualitative analysis and that the results of this analysis would give a good indication of the effect of the implementation of a constructivist-informed, computer-mediated course in PLGY232 on student performance. However, it was not possible to apply

rigorous qualitative methods historically to PLGY232 in 2001. However, it was decided that this comparison would still be undertaken to ensure that the implementation of PLGY232 in 2002 did not have a detrimental affect on the performance of the students, despite the fact that there are too many assumptions to state conclusively that the implementation of the course had an affect on student performance, knowing that this conclusion would not stand up to scrutiny.

If we make the very broad assumption that the only change that occurred between 2001 and 2002 that would influence student performance was the implementation of a constructivist-informed, computer-mediated course, an assumption that we cannot make with any degree of confidence, then it would appear from the results in Section 4.2: The Effect of the Course on Student Achievement, concerning student performance that the implementation of this course had a positive influence on student performance.

Be that as it may, the fact is that the results obtained from the comparison of student performance in 2002 with student performance in 2001 do indicate that the students performed better in 2002 than in 2001.

5.6.1 Student Performance and the Research Questions

Research Question 5

What effect did the implementation of this course have on the academic achievements of those participants?

Though it was not possible to apply rigorous quantitative methods to the calculation of the comparison of student performance in 2002 with student performance in 2001, the results obtained from this calculation would indicate that students performed better in 2002 than in 2001. What is important in the opinion of this researcher is the fact that it appears that the implementation of this course did not have a negative effect on student performance. However, attention will have to be given to the approach to measuring this aspect of the implementation study in future.

5.7 Assumptions

In Section 2.6.1: Assumptions, a number of assumptions were made. In the first instance it was assumed that the redesign of this second year course in Physiology would have a positive influence on student satisfaction with the course. The results of the qualitative and quantitative analysis with respect to student satisfaction in Sections 4.1: Student Perceptions of the Course and 4.2: The Effect of the Course on Student Achievement, supported by entries in the researcher's reflective journal and discussed in Sections 5.1: The Course in Relation to the Theoretical Framework, 5.2: Student Perceptions of the Course and 5.3: The Researcher's Reflective Journal and Student Perceptions, would indicate that this assumption was, in fact, correct.

In the second instance it was assumed that the redesign of this second year course in Physiology would not negatively impact on student performance. While the methodology used to test this aspect of the implementation of the course may not stand up to rigorous scrutiny, the results obtained in Section 4.2: The Effect of the Course on Student Achievement and discussed in Section 5.6: Student Performance, would indicate that the implementation of this course did not negatively impact on student performance and that this assumption was, in fact, correct.

In the third instance it was assumed that, given the students' background from both an educational experience and a technology experience point of view, the students would experience difficulties with the approach to the course and with the use of technology. The results of the qualitative and quantitative analysis with respect to student satisfaction in Sections 4.1: Student Perceptions of the Course and 4.2: The Effect of the Course on Student Achievement, supported by entries in the researcher's reflective journal and discussed in Sections 5.1: The Course in Relation to the Theoretical Framework, 5.2: Student Perceptions of the Course and 5.3: The Researcher's Reflective Journal and Student Perceptions and, the results of the analysis of student performance in Section 4.2: The Effect of the Course on Student Achievement and discussed in Section 5.6: Student Performance would indicate that neither the use of technology nor the approach caused the students any significant difficulties. In fact, it would appear that just the opposite occurred and that, despite the students' background, both from an educational experience and a technology

experience point of view, the students relished their exposure to both the technology employed in support of the course and the constructivist approach implemented as a result of the design of this course.

Chapter 6: Conclusion

This study represented the first tentative step towards a comprehensive study measuring the implementing technology-mediated, constructivist-informed courses at the University of the North. The many flaws in the design of this study have been highlighted throughout this document and as much attention needs to be given to improving the research design of this implementation study as needs to be given to improving the implementation of the courses themselves. However, each journey begins with the first step.

The most important finding of this study, in the opinion of this researcher, is the fact that all indicators point to the fact that, for the most part, the students thoroughly enjoyed themselves in a technology-mediated, constructivist-informed learning environment. This, despite the reservations expressed by this researcher with respect to the educational and technological background of the student participants in the study, reinforced by the gainsayers who predicted disaster. Moreover, this learning environment appears to have had a positive affect on student performance.

But is this enthusiasm sustainable? This will be a matter for future research projects to determine.

6.1 Research Approach

As has been mentioned, it was not possible to apply the rigorous statistical methodology required to meaningfully answer Research Question 1. Furthermore, it has been pointed out that the open-ended questions in the Subject Evaluation Questionnaire were not interpreted by the student participants in the way that the researcher expected. As with implementation studies used by researchers to determine shortcomings in the implementation of courses, so the research approach can be improved by identifying flaws and improving the methodology. In this section the author will propose a research approach with respect to the implementation of online courses to be followed by the University of the North in order to monitor and

improve the effects of such implementation over a period of time so as to make the implementation study a more meaningful exercise.

Bemoaning the poor quality of research in the field of education technology Reeves and Hedberg (2003:273) endorse the “use-inspired basic research” development approach to researching educational technology. The goals of this approach are, according to Reeves and Hedberg (2003:271), focused on:

... the dual objectives of developing creative approaches to solving human teaching, learning, and performance problems while at the same time constructing a body of design principles that can guide future development efforts.

Figure 10 is a diagrammatic representation of the development research approach taken from Reeves and Hedberg (2003:274).

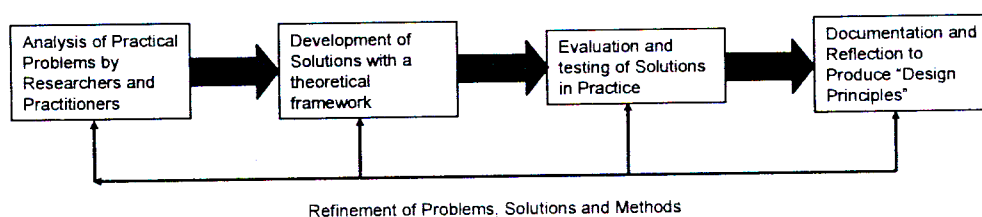


Figure 10: Development approach to research in learning technologies

Collaboration amongst practitioners, researchers and technologists is, according to Reeves and Hedberg (2003:275) at the heart of development research, which aims to benefit all stakeholders.

Development research involves collaboration between researchers and practitioners, selecting from a number of methods in order to achieve the goals of the programme, modifying tool selection when required (Reeves and Hedberg, 2003:277).

Development research involves the creation of design principles and the sharing of results in order to contribute to the improvement of the use of educational technology as a tool in education curricula (Reeves and Hedberg, 2003:277).

At the end of this thesis it is suggested that a development research approach to future studies involving the implementation of computer- and World Wide Web-based educational technologies will make a meaningful contribution to the construction (and reconstruction) of design principles that guide this implementation, with specific reference to the problems faced by an historically disadvantaged institution, such as the University of the North.

6.2 Final word

This has been an incredible journey made all the more rewarding through interaction with fellow travellers, in particular the students who participated in this course and whose enthusiasm for the course was a continual inspiration. It has been said that students will live up to what is expected of them and it was almost as if this group of students had been waiting for a course to come along in which they could prove themselves, despite their background, which has been alluded to throughout this document.

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¹ Referred to in about 63 education-related sites using the following search parameters "Behaviourism as a Learning Theory" Black or "Behaviorism as a Learning Theory" Black. Unfortunately neither this link nor an alternative that the author found at <http://soclink.csudh.edu/wisc/dearhabermas/alfiek.htm> currently work.

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